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Summer 2000

MAIC Mine Action Information Center
AT JAMES MADISON UNIVERSITY

Deminers, Manual Demining and their Personal Protective Equipment

Conference Calendar

September 11-15, 2000

Second Meeting of States Parties to the Mine Ban Treaty

Geneva, Switzerland

No contact information yet. Look for updates at: www.icbl.org/calendar.

September 19-20, 2000

Use of Satellites and Integrated Technologies for Humanitarian Purposes, co-organized with the EC/Joint Research Center

Ispra, Italy

The Conference will cover four topics, namely: humanitarian demining, movement of refugees and other displaced persons, food and water security and tele-medicine. For further information, please contact: Ms Valerie A. Hood, Secretary General, EURISY Association 3-5 rue Mario Nikis, 75015 Paris, France Tel: + 33 (0)1 47 34 00 79 - Fax: + 33 (0)1 47 34 01 59 - E-mail: eurisy@micronet.fr.

October 2-4, 2000

CLAWAR 2000

Madrid, Spain

Organised by the Thematic Network on Climbing and Walking Robots (CLAWAR), funded by the European Commission under the Brite Euram Programme. The aim is to bring together not only people engaged in developing CLAWAR robots, but also to encourage interaction with research groups engaged in fundamental work on mobile machines and associated support technologies. The interest in climbing and walking robots has increased over recent years and there is a growing need to widen the applications base for this area of technology. Current applications include humanitarian demining. For more information, write to: INSTITUTO DE AUTOMATICA INDUSTRIAL, Carretera de Campo Real Km. 0,200, 28500 La Poveda - Arganda del Rey - Madrid, Spain, or visit their conference website at: www.iai.csic.es/clawar2000/ or you can E-mail for more information to: clawar2000@iai.csic.es.

October 25-26, 2000

Regional Conference on Landmines

Hosted by the Government of Djibouti and sponsored, in part, by the U.S. State Department. For more information, contact Mr. Hesa at: ahesa@rocketmail.com.

October 29-November 1, 2000

Enhancing Mine Detecting Dog (MDD) Operations - A Practitioner's Perspective

San Antonio, Texas

Co-hosted by the U.S. Department of State and Slovenian International Trust Fund for Demining and Victim Assistance in Bosnia & Herzegovina and supported by the James Madison University Mine Action Information Center (MAIC). Workshop will bring together selected MDD trainers, handlers and other dog specialists to examine ways to improve current MDD performance through training modifications, accreditation, integration into demining operations and better MDD planning and coordination. More information to follow. For further information, contact Joe Lokey, Deputy Director, MAIC, at Tel: (540)568-2715; Fax: (540)568-8176; E-mail: lokeyfj@jmu.edu or hdic@jmu.edu.

March 27-30, 2001

2nd Australian-U.S. Joint Conference on Mine Technologies and Mine Countermeasures

Sydney, Australia

Co-hosted by the Defence Science Technology Organization (DSTO) of Australia and the Mine Warfare Association (MINWARA) and will cover all aspects of naval mine warfare, land mine warfare, humanitarian and peacekeeping demining. For more information, contact Al Bottoms: amb@minwara.org.

July 1-6, 2001

International Society of Prosthetics & Orthotics (ISPO) 10th World Congress

Glasgow, U.K.

Looking to attract about 1,500 doctors, surgeons, engineers, prosthetists, orthotists, physio and occupational therapists active in the fields of prosthetics, orthotics and rehabilitation engineering. For more information, contact Colin Peacock at ISPO 2001 Congress Secretariat, c/o Meeting Makers Ltd., Jordanhill Campus, 76 Southbrae Drive, Glasgow G13 1PP, U.K.; Tel: +44-141-434-1500; Fax: +44-141-434-1519; E-mail: ispo@meetingmakers.co.uk; or visit their website at: www.I-S-P-O.org.

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Upcoming Issues

Version 4.3	October 2000	Mine Awareness
Version 5.1	February 2001	Landmines in Asia and the Pacific
Version 5.2	June 2001	Landmines in Latin America
Version 5.3	Oct 2001	Landmines in the Middle East
Version 6.1	February 2002	Global Mine Action Centers
Version 6.2	June 2002	Landmines in Africa
Version 6.3	October 2002	Victim & Survivor Assistance
Version 7.1	February 2003	Manual Demining and Personal Safety
Version 7.2	June 2003	Landmines in Europe & The Caucasus
Version 7.3	October 2003	Mechanically Assisted Demining

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The Journal of Mine Action reserves the right to alter articles for readability or space considerations. Every effort will be made to maintain the integrity and meaning of the text.

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The U.S. Approach: Deminer Personal Protective Equipment Development

by Col. George Zahaczewsky,
U.S. Army Office of the Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict

The deminer and his partner began work at 0730. By 0850, they had cleared 50 square meters. Both men wore frag-jackets, helmets and visors. The victim was clearing by using his prodder. He was called to help his section leader remove grass from a large pothole in the road. As he returned at 0850, he stepped on a mine he had previously missed. (Extracted from the Database of Demining Incident Victims, 1999, Incident #53.)

At around 1110, the deminer got a detector reading and began prodding and excavating the ground using a bayonet held in his left hand. A PPM-2 mine detonated. The victim was knocked backward about two meters by the blast and was lying partly in an uncleared area. He stood up quickly, leaving his visor that had been blown away and broken by the blast. The victim received first aid and arrived at the field hospital at 1120. The victim's visor was described as riddled by fragments and broken at the weak points of the articulation on both sides of the head frame. His frag jacket stopped all projections, limiting injuries to the most exposed parts. (Extracted from the Database of Demining Victims, 1999, Incident #63.)

The Supervisor was a highly experienced UXO specialist. He was placing charges on damaged PMD-6 mines found by deminers to destroy them. He placed one charge by a PMD-6 and stood up to move to a second mine only two meters away. As he stood, he tripped and fell, landing on the second mine. He either landed on his hand or his knee on the left side, knocking the pin from the MUV switch/fuze in the mine as he did so. In the detonation, he suffered traumatic amputation of his left knee and left arm. He also had blast injuries on the left side of his face and chest. The chest injuries were light because the victim was wearing a fiberglass back support as a result of an earlier, non-demining related injury. He was not wearing any protective equipment. His eyes were undamaged. The victim remained conscious. He was the radio operator on site, so he had to explain to others how to call for the helicopter medevac. (Extracted from the Database of Demining Victims, 1999, Incident #19.)

Introduction

In 1998, the United States placed increasing emphasis on developing Personal Protective Equipment (PPE) for the individual operator engaged in humanitarian demining. It was believed that development of improved PPE suitable for humanitarian demining was well within the bounds of currently available technology. During the previous year, several conferences had highlighted the need for better protection of deminers. In March 1998, the U.S. Department of Defense—through the Night Vision and Electronic Sensors Directorate—hosted a Mine Action Center Workshop to specifically focus on individual deminer needs. Foremost among the requirements of workshop participants was the need to develop PPE that was specifically designed and developed with the deminer in mind. The characteristics of deminer "body armor" that were discussed at this workshop included: affordability, lightweight and modularity allowing flexibility to tailor the PPE to the specific needs of individual deminers and environments.

Research

To better focus the development of deminer PPE, NVESD was requested to conduct a market survey of existing body armor as well as undertake research to better understand the nature of deminer injuries. Additionally, the U.S. Army's Surgical Research Institute in Fort Sam Houston, Texas, was contracted to conduct extensive research into landmine injuries of the lower extremities. Its research efforts in the Lower Extremity Assessment Program are discussed further in this journal.

Additionally, NVESD partnered with the Army's Natick Laboratories and Aberdeen Test Center as well as the Canadian Centre for Mine Action Technologies to conduct extensive blast effects testing on existing PPE. NVESD also embarked on a program to develop demining PPE that could be made commercially available within a short period of time. To this end, NVESD contracted with Med-Eng Systems of Canada to develop the Humanitarian Demining Ensemble, which is currently available and has already been purchased for use in South America and the Middle East.

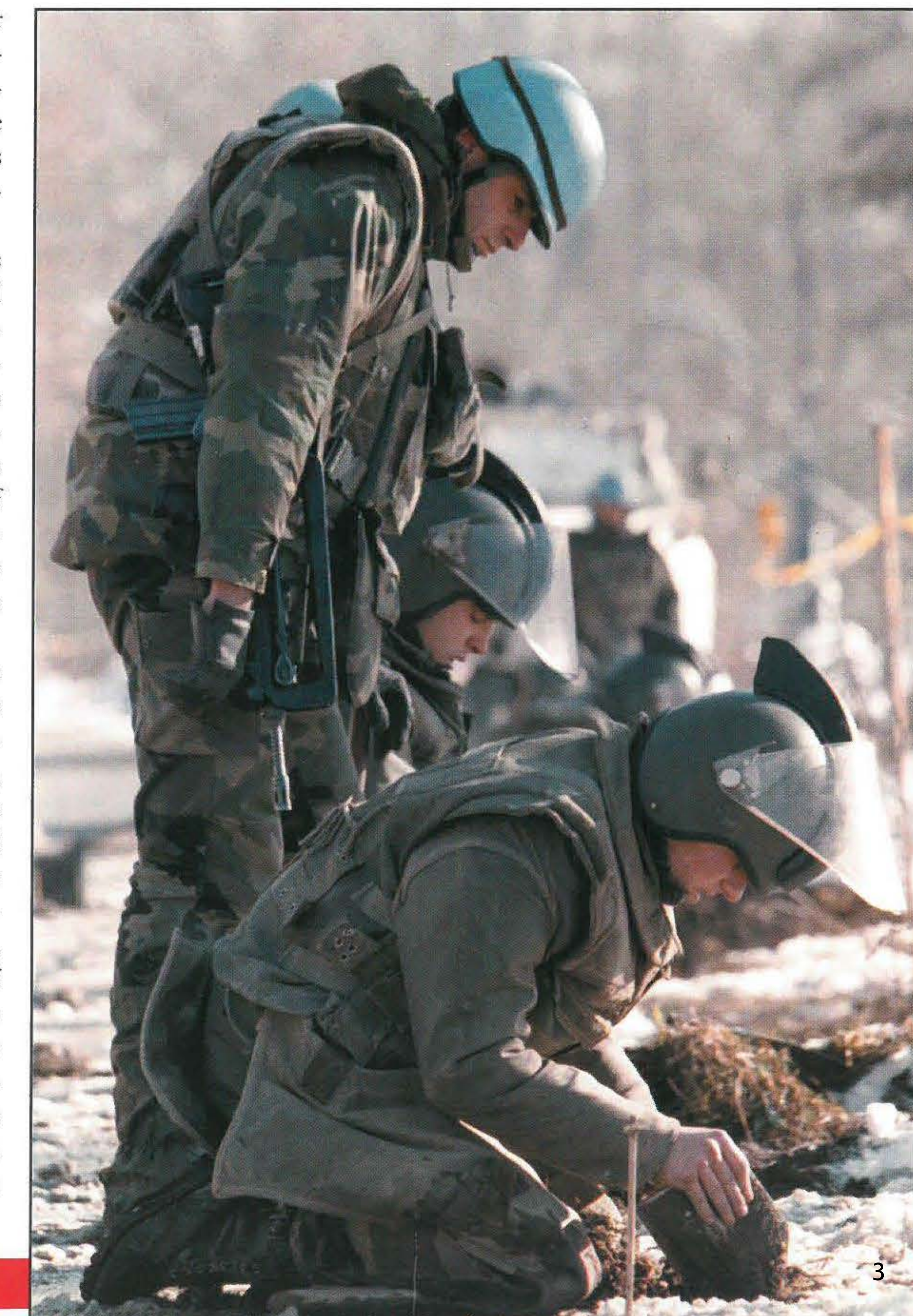
Furthermore, NVESD worked with Andy Smith to develop PPE that could be locally produced in a mine-affected country. The U.S. demining technology development program endorses both approaches, i.e., development of commercially available PPE for demining organizations and donors who can afford to buy it as well as locally manufactured body armor for countries wishing to establish an indigenous capability. The caveat in this endorsement, of course, is that both meet minimally acceptable standards of protection. Finally, the further services of Andy Smith were retained to gather field data pertaining to deminer injuries. Due primarily to his significant interest in PPE as well as his access to and knowledge of several demining theaters, it was felt that Smith had an extremely useful insight and perspective on deminer injuries.

Landmine Casualty Data Report: Deminer Injuries

Smith's research was carried on from September 1998 to June 1999. Deminer injury information was gathered from Afghanistan, Angola, Bosnia-Herzegovina, Cambodia, Cuba (Guantanamo Bay), Iraq, Laos, Mozambique and Zimbabwe. In many cases, it was possible to gather information directly through interviews with the individuals involved. In other instances, pertinent information was extracted from investigative, medical and insurance reports. Eventually, information was collected covering the period from 1993 through 1998, on 236 incidents, involving 301 victims.

An independent analysis of Smith's database by

Personal Protective Equipment must take into account the deminers' safety and comfort.
Photo c/o AP/World Wide Photos



Injuries to the legs and head are the most common injuries suffered by deminers.
Photo c/o Will Boyce

the U.S. military's Casualty Care Research Center in Bethesda, Maryland, produced a study entitled "Landmine Casualty Data Report: Deminer Injuries," which is possibly the first of its kind. This analysis revealed some particularly useful information pertaining to deminer injuries and their causes. It was found, for example, that the most common landmines causing injuries and, in some instances, death, were AP blast mines. The most commonly encountered mines in this category were the PMN, PMN-2 and the Type 72. The activity that deminers were most often engaged in when an incident occurred was prodding, which accounted for 29 percent of the incidents. Although some demining practitioners claim that missing mines should not occur, it does, accounting for 26 percent of the incidents.

Upon further review of the data, it was determined that the legs were the most common location of deminer injuries with 63 percent suffering injuries to their lower extremities. Injuries to the head were the next most common occurrence (56 percent), the arms (55 percent), the torso (33 percent) and the eyes (30 percent). In those suffering eye injuries, 10.5 percent sustained permanent blindness. Thirty-seven of the deminers involved in incidents became fatalities (12.5 percent). The majority of these were killed while clearing vegetation.

The study draws several conclusions that can be implemented today to help reduce deminer injuries. Among these are that deminers should wear facial and eye protection. Additionally, deminer injuries and deaths could be reduced through improvements in PPE, procedures and medical response. Finally, the study draws the potentially contentious conclusion that the accumulated data presented in the research "was insufficient to show any effect of the wearing of an armor vest, jacket or apron for either minor or severe injuries and therefore does not prove or disprove the effectiveness of this type of protective equipment."

The study goes on to recommend that a standardized format be developed and adopted for reporting mine incidents and injuries. The data in the study also supports the "need to develop and establish test and evaluation protocols for measuring the effectiveness of protective equipment (i.e., minimum standards) against mines that are likely to be found in demining operation environments." Additionally, the study recommends that additional data be obtained validating the effectiveness of protective vests, jackets or aprons. Finally, analysis of the data suggests that research and development into more effective footwear has the potential to mitigate the most common form of lower extremity injury—amputations, which occurred in 42 percent of the cases of leg injuries.

Conclusion

Although the United States anticipates concluding the majority of its research and development into deminer protective clothing during fiscal 2000, modifications and testing of existing PPE will continue throughout the duration of the program. Additionally, development and testing of visors, helmets and deminer hand tools will also continue. The rationale for this is that PPE should be considered as an integral part of a deminer's "tool box," not just simply as a nice-to-have accessory.

As such, future development as well as testing of PPE should use a systems-oriented approach. For example, visors should not be tested separately but should be evaluated in conjunction with the helmet they will be attached to or the protective vest that they will interface with. It is only in this manner that their full strengths and weaknesses will be identified.

Copies of Andy Smith's Database of Demining Incident Victims can be obtained by contacting him directly. The "Landmine Casualty Data Report: Deminer Injuries, February 2000," can be viewed on the Night Vision Electronic sensors Directorate website at www.demining.brtrc.com. ■

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Personal Protective Equipment:

The Never-Ending Story

HANDICAP INTERNATIONAL

by Lance J. Malin,
MBE Program Manager, HI Demining and EOD Operations, Kosovo, May 2000

Introduction

Now, as always, there is a huge debate about what protection is required and what Personal Protective Equipment (PPE) should be provided for personnel engaged in demining operations. Current opinion varies drastically between individual demining organizations, countries in which they operate and between governing bodies, which are coordinating the demining efforts.

Each organization within the demining community has a different view of what is required and what should be provided. These views are, in most cases, based on a variety of factors, such as experience, local customs, donor policy, a possible lack of understanding (due to the absence of independent information) and cost.

Very few independent and objective studies about the requirements and possible solutions have been carried out and widely circulated. A good start was made last year by the establishment of a focus group during a meeting in Washington D.C.[1], and the results, which were due to be promulgated in 1999, are eagerly awaited.

Overall, given the multitude of other types of studies carried out each year, many of which tell us what we already know, the general lack of funding designated for research on PPE is disturbing.

Aim

My goal is to highlight the current standard and type of PPE in use with Handicap International (HI) deminers in the Balkans and to explain why this standard and type of PPE was chosen. If I succeed in contributing to a bit of controversy, so much the better, for this subject deserves a more important place on the agenda. Ultimately, this emphasis should lead to appropriate PPE being supplied to all deminers worldwide as a right. Donors and funding agencies should then be encouraged to enforce this practice by understanding the requirements and insisting that their operators conform to an acceptable and recognized standard.

Our Own Experiences: 1991–1995

All of us involved in mine clearance are, to some extent, victims of our past. My own perceptions were formed as an Ammunition Technical Officer (ATO) for a number of years in the British Army. "Demining is not a sport for ATOs!" my colleagues from the Royal Engineers often remind me. Nevertheless, the concept of PPE is not new to me, both from the perspective of an ordinary soldier and as a Bomb Disposal Technician. I have worn the best equipment the British Army had to offer in a variety of circumstances, and I count myself as one of the lucky ones not to have had it tested by an explosion.

Focus

In March 1991, I went to Kuwait as part of a Royal Ordnance (RO) field evaluation team to look at the EOD problems (including landmines) remaining after the Iraqi occupation and the subsequent liberation by the coalition forces. The task for RO was to clear over 2,500 sq. km of desert, including small villages and oilfield industrial complexes. This task involved both Battle Area Clearance (BAC) and conventional mine clearance. The operations director, who had been specifically contracted for this task, made an assessment at that time that for BAC, ballistic protection was not required. Conversely, in the case of the mine clearance, it was decided that the best available ballistic protective equipment, suitable for the environment and the threat, should be procured and worn during mine clearance operations. This equipment would consist of, at a minimum, a helmet, visor, ballistic jacket and trousers. Also, overboots made of ballistic material that covered the lower leg from knee to foot were made available. Their use was optional.

The protective equipment provided was originally designed for military use and was composed of "off the shelf" items that the military felt were suitable. In 1991, as far as we were aware, there was no such thing as a "demining suit" designed specifically to meet the needs of commercial/humanitarian mine clearance. Figure 1 illustrates the original equipment.

In total, over 361,000 landmines were cleared by RO demining teams during the clearance operations between July 1991 and July 1993. Tragically, during demining operations, three British deminers were killed and six others suffered traumatic amputations to their lower limbs. These mine-related fatalities were caused during location, neutralization and disarming activities. Valmara V69s caused two casualties, which are large AP bounding fragmentation mines, and the third by a PT-Mi-Ba-III AT mine. Unfortunately, in the cases of the fatalities, the deminers were directly over the mines when they detonated, and it is unlikely that any practical protective equipment would have saved them. However, in the case of one victim, it was concluded that if upper arm protection had been available and had been worn, then the damage to the brachial arteries would have been less severe, and the chances of survival, in such circumstances, might have been improved. A redesigned suit, including integral upper arm protection and a high collar, was procured.

Figure 1: The original demining suit worn by the Royal Ordnance field evaluation team in Kuwait.

Photo c/o HI

In all fatal cases, there was little penetration of the body armor (including helmets and visors) worn. Unfortunately, the massive explosions at such close range caused terrible blast and fragmentation injuries to unprotected extremities. Demining personnel stepping on small AP blast mines caused all the traumatic amputation cases. VS-50s caused two accidents, and T72s caused four.

Partly as a result of this high number of accidents to lower limbs, foot protection was considered, and a market study was undertaken. The only practical type available, at that time, was the Pakistani Blast Boot, which was actually in use in Kuwait by the Pakistani Army demining teams. The boots are worn by the deminer in Figure 1. This type of boot had the advantage of having been "tested" operationally in Kuwait by several Pakistani military deminers who had inadvertently activated PMN AP mines during their operations. The protection afforded by the standoff distance and the Kevlar materials in these boots appeared to prevent traumatic amputation.

Accordingly, this type of foot protection was procured and issued to RO deminers as soon as it became available. As this action took place toward the end of the contract when the Gurkha teams were carrying out the majority of the demining, there were fortunately no further "test" incidents.

During my time in Kuwait, I experienced several graphic and tragic illustrations of what could go wrong during demining operations. I had the opportunity to experience first hand the "pleasures" of wearing full body armor in the heat and humidity of the Kuwait summers during 1993-94, when temperatures reached in excess of 50 degrees Celsius. In short, the comments on the subject of PPE that follow are derived from my personal experience and are made in full awareness of the limitations that PPE can impose on the practical aspects of demining activities in a variety of environmental and threatening conditions.

International Standards for Humanitarian Mine Clearance

During my time in Kuwait, the concept of humanitarian mine clearance was developing within the international community. One concern for funding demining was deminer security. There were differing views on whether this concern was about the deminers or about limiting donor responsibility. The need for some kind of standard was not disputed, but the question of who should determine these standards and how they should be implemented and monitored still has not been fully explained.

In July 1996, at a conference in Denmark, the broad outlines of a set of international standards were proposed by working groups. These were revised and developed by a separate U.N. led working group that promulgated in March 1997, at a conference in Tokyo.

These standards were issued under the auspices of the U.N. and were effective upon receipt. They were to be the framework for the creation of Standing Operating Procedures (SOP), and it was generally assumed that they were to be taken as the *minimum* standards to be adopted by all U.N. sponsored demining programs worldwide. They were to provide "an example or principle to which others conform, or should conform."[2]

In the case of PPE, there were concerns expressed by some manufacturers and their spokespersons regarding the suitability of the testing standards[3] (V50 rating NATO STANAG 2920), as outlined in the U.N. International Standards document. As far as I am aware, no one has come up with a suitable alternative.

Demining for HI in Bosnia: 1997–1999

In September 1997, I assumed responsibility for the HI Demining and EOD program in Bosnia. This project was UNMiBH funded and equipped with technical oversight from the UNMAC in Sarajevo.

In the U.N. project documents and terms of reference for the project, the importance of conforming to the U.N. International Humanitarian Demining Standards was repeatedly underlined. The concern about adherence to these standards turned out to be so intense that the U.N. took responsibility for the procurement of all of the original equipment. Yet, despite HI protestations, the PPE supplied was not thought to be compliant with U.N. standards. In particular, the helmet and visor (6mm-polycarbonate) combination was well below requirements, and the "protective vest" was no more than an off-the-shelf military flak jacket procured on the basis of cost, rather than effectiveness. This equipment was better than the PPE worn by a great number of deminers in many countries but was, in the opinion of HI, well below the intended equipment in accordance to the U.N.'s own standards. This failure to meet U.N. regulations was particularly unfortunate since the budget for the project included funding for much more suitable, substantial and probably more cost effective equipment.

Despite numerous requests from HI regarding the testing standards of the equipment, the UNMAC refused to discuss the level of protection offered by the equipment it supplied nor would it confirm in writing that the equipment met the minimum requirements as stated in the U.N. standards. Figure 2 illustrates the PPE issued by the UNMACC to HI deminers in Bosnia in1997.

Arguments fell on deaf ears, and it soon became obvious that the U.N. was implementing its international standards, as they claimed the need for flexibility that they did not practice. The notion that "whistle blowing" would create difficulties did not go unnoticed by other agencies dependent on U.N. channelled funding or approval in Bosnia. Sadly, the most vociferous critics of the UNMAC confined their protestations to bars in Sarajevo on Friday nights. When asked to become part of a united front to express the concerns of the demining community in a manner that the UNMAC would have to acknowledge, support was sadly lacking.

It would be unfair to assume an absolute equivalence of attitude between institutions and individuals. Eddy Banks, one of the World Bank advisors, was attempting to gain some clarification about the whole subject of PPE and injuries and was producing some interesting statistics. In his paper, "Protection or Deception," he tried to quantify the benefits (or lack thereof) of various PPE systems used by deminers when they had been involved in accidents in Bosnia. One of his conclusions was that a scientific study involving doctors as well as PPE designers was needed to evaluate the majority of PPE that was in current use and to come up with designs specifically for humanitarian demining. One fact that emerged was that over half of the demining accidents in Bosnia at that time (57 percent) had involved deminers stepping on mines, yet no protection for feet and lower limbs was provided by any organization.

Figure 2: The U.N. issued demining suits to Handicap International deminers in Bosnia in 1997.

Photo c/o HI

New, Improved Protection?

Despite an apparent lack of tangible concern about PPE, HI based its decision on concrete evidence and sought donors for funds to replace the UNMAC issued PPE in addition to protection for the deminers' feet. The Irish Government was sympathetic to HI's requests, and it made funds available for the purchase of improved PPE and foot protection for all field personnel.

Meanwhile, in the general marketplace for demining equipment, a number of manufacturers had produced and started to market what they termed "humanitarian demining suits." Most of these units were development prototypes that had never actually been tested by deminers carrying out routine duties in realistic environments over normal lengths of time. Investigation revealed that the "testing procedure" for the marketed PPE systems had amounted to little more than having various persons trying them on during focus groups and seminars. This method was not the only source of testing, but it did seem to be the one that carried the most weight among those responsible for setting procurement standards.

As cynical as the above may sound, to be fair, I must admit that I speak from experience. My scepticism is based on my own career as a successful salesman in the defense industry. Based on my experience, I am well aware of how to influence the decision-makers who purchase PPE. There is rarely enough input from the deminer who has to wear or use the equipment. It is from my experience with both perspectives, the commercial and the end-user, that I come down heavily on the side of developing a system that minimizes the effects of these differing priorities.

During our search for new equipment, one supplier who seemed to be asking the right questions regarding the perceived requirements and who was willing to discuss and develop a product with the actual users was UK based RBR. A prototype of proposed designs for humanitarian deminers operating in temperate climates was sent to HI in Bosnia, and several deminers wore this kit for regular operations over a number of weeks. Comments were solicited, and a few modifications were discussed. The requirement to protect the head, neck, torso and main arteries in the arms and legs was satisfied by the final modified prototype. The collar of the jacket extends beyond the visor (contrary to U.N. International Standards) in order to deflect blast and debris over the visor and helmet. A visor that extends beyond the collar can, in effect, funnel blast and debris into the deminer's face. For deminers, the complete system consists of a helmet (V rated at 450m/s for a 1.102g fragment), a visor (V50 rated at 600m/s for a 1.102g fragment) and protective jacket and wrap around trousers (V50 rated at 475m/s for a 1.102g fragment). Figure 3 illustrates the complete system.

Figure 3: The modified demining suit worn by Handicap International deminers in Bosnia and Kosovo.
Photo c/o HI

The wraparound design of jacket and trousers brings up one important point about our approach to protection for demining personnel, an approach regarding the level of protection that should be offered to the back and sides of deminers. This belief is not universally shared by other organizations. Many argue that the main threat while demining in the kneeling, squatting or standing positions (the most common positions used by deminers despite what SOPs may say) is to the front and to the groin. This fact is not disputed, but when group fragmentation mines, such as the PROM-1 and PMR series of mines, are also present, each possibly attached to 16m long tripwires, then the possibility of a fragment hitting other deminers in the vicinity is very real. This scenario would be the case even if spacing between deminers in such circumstances were increased to 50m. It is unlikely that all deminers would, at the time of detonation, be facing the mine when it was activated. In fact, it is possible that a mine in such circumstances may detonate to the rear of several deminers who may be, at that moment, standing up.

Based on this argument and supported by what we consider to be "duty of care" for demining personnel and common sense, the PPE used by HI in Bosnia and Kosovo has 360 degrees protection for the head, neck and torso. It also includes integral protection for the upper arms, armpits and groin. With the combination of trousers and jacket worn during demining activities, there is twice the thickness of ballistic material protecting the groin (femoral arteries). The rear panel of the jacket can be removed, if necessary, as dictated by the threat. For field support staff not involved in actual location, neutralization and disarming of mines, the trousers are optional.

For Bosnia and Kosovo operations, the Americans manufactured Welco's Blast Boot, which was issued by the U.S. Armed Forces to several of its units. Various other sources of boots were investigated, but the Welco boot appeared to be the most practical. Figure 4 illustrates these boots, which are issued to all demining staff.

The entire system, from head to foot, was developed keeping in mind the obvious limitations imposed by the deminer's need to move relatively freely, to have vision unimpaired and to maintain a level of physical condition and mental alertness throughout the day. The objective is to achieve the best possible compromise between absolute protection and practical constraints.

What Protection Is Required?

One of the characteristics of Western consumers is that having made a purchase they develop arguments to confirm that the decision to buy a particular product was correct. We are no different in the demining world, and the reduction of "post purchase dissonance" is a factor to be considered. This discontent is why it was somewhat reassuring to see an article about fragmentation injury in the *World EOD Gazette*[4], which seemed to confirm that the factors considered in the decision to purchase the PPE were generally sound.

The article concludes that "the NATO STANAG V Test Specification system was never designed to be, nor should it be employed as, a procurement comparison tool." This statement implies that the object of procurement of PPE should not be purchased to "standard," but rather purchased to "threat." Threat analysis is something deminers do know about and are capable of debating and explaining within an essentially shared knowledge framework. In the absence of any other analysis system, it is unlikely that the U.N. International Standards for Humanitarian Demining will deviate from the NATO STANAG set benchmark in the foreseeable future. However inadequate, or indeed unrealistic, the current method of assessing the performance level of materials, it will remain the criteria against which products are judged.

Conclusion

Until some other more suitable criteria for evaluation than the current V rating is developed, those of us who are forced to choose between PPE manufacturers and designs will have to go on educated guesswork. The need is not so much for standards but for measures. Such measures must provide the means to determine the level of PPE appropriate to a given set of actual circumstances and threats. PPE in one situation does not have to look or be exactly like PPE in another, but until operators can explain their choices in coherent and comparative terms, donors, procurement officers and deminers alike will have to live with, in the best case, educated guesswork. In the worse case, deminers will live—or die—according to an all too loose definition of the minimum standard. ■

Figure 4: Welco Blast boots used by Handicap International deminers in Bosnia and Kosovo.
Photo c/o HI

[1]See JMU *Journal of Mine Action* Summer 1999, "Body Protection Systems for Use in Humanitarian Demining," by Richard L'Abbe, Dr. Aris Makris, Mr. Derrick Poon Young.

[2]Concise Oxford Dictionary.

[3]World EOD Foundation Gazette, July 1998 – Blast effects on the Human Body, R.A. Purvis.

[4]World EOD Gazette, January 1999, Fragmentation Injury, page 42.

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Development of a Procedure for Evaluating Demining Protective Equipment

by Cameron R. Bass,
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Introduction

The human toll from AP mines is large. The United Nations estimates that there are over 100 million AP mines deployed worldwide (U.N. 2000). An estimated 20,000 civilians die each year from landmine explosions. Thousands more are wounded and maimed. As there is still no inexpensive and reliable mechanical technique for removing AP mines, human deminers will be used in the foreseeable future to protect the general population from the menace of landmines.

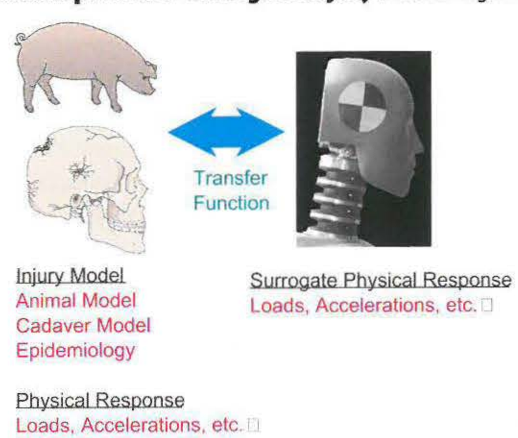
To decrease the human toll from demining, protective equipment should be used. For comprehensive protection, the demining ensemble may include head/face protection, thorax protection and extremity protection, including gloves and boots as shown in Figure 1. This ensemble offers the potential for substantial protection against fragments, blunt force trauma, burns and other consequences of mine blasts. However, without some objective procedure to evaluate the risk of injury while wearing protective gear, the design of such demining equipment is guesswork. Indeed, without an effective injury evaluation technique, protective equipment may exacerbate certain types of injury. For example, the introduction of body armor in Northern Ireland for protection against blast fragments may have increased the potential for blast lung injuries (Mellor 1989).

One technique that has been shown to be effective in the automobile industry is the use of an instrumented surrogate (dummy) to evaluate the risk of injury from blunt trauma in automobile crashes. Elements of this technique include the following:

- **Biofidelic surrogate** – A dummy that is robust, gives a repeatable physical response and responds in a human manner. A dummy may be physically very simple and may only represent a part of a human. For example, an instrumented beam has been used success fully to represent an arm (Bass 1997). However, dummies may be very complex, such as the anthropomorphically-correct dummies developed for the automobile industry. Generally, a surrogate should be as simple as possible while still representing the relevant human response.
- **Engineering measurement** – A physical parameter such as force or acceleration that may be used to quantify the physical response of the dummy. Dummies may be instrumented to produce accepted or proposed injury criteria.
- **Injury risk evaluation** – A correlation between an engineering measurement and some injury model. For example, in frontal thoracic blunt impacts, an injury threshold of 60 times the force of gravity is used in the automobile industry.
- **Validation by injury model** – A correlation between the injury risk evaluation and a physical model of injury. 1) Epidemiology or physical reconstruction of an actual injury event; 2) An animal injury model; or 3) A cadaver human injury model as shown in Figure 2. Development of a relationship between a robust surrogate for injury and a validated injury model is crucial in the success of this approach.

Demining Ensemble Figure 1

Development of Surrogate Injury Model Figure 2



Two other important elements of injury simulation may be adapted from those used in automobile testing: use of injury epidemiology to direct testing and injury modeling and use of realistic test conditions. Both limit the risk that an injury simulation is simply an academic exercise and is not applicable to real world conditions.

Widespread use of this technique has saved thousands of lives per year in the automobile industry. As there are similarities in human blunt trauma in an automobile crash and in a blast event, this technique may be adapted to evaluate injury from mine blasts.

Development of Procedure

The goal in the current study is to develop a procedure to evaluate injuries from mine blasts, borrowing tools from existing techniques when appropriate. This approach will result in an objective test criterion for the evaluation of the injury risk of a human wearing a protective demining ensemble. It will allow this injury risk evaluation for protected or unprotected subjects and will indicate the relative levels of protection for subjects wearing different protective equipment.

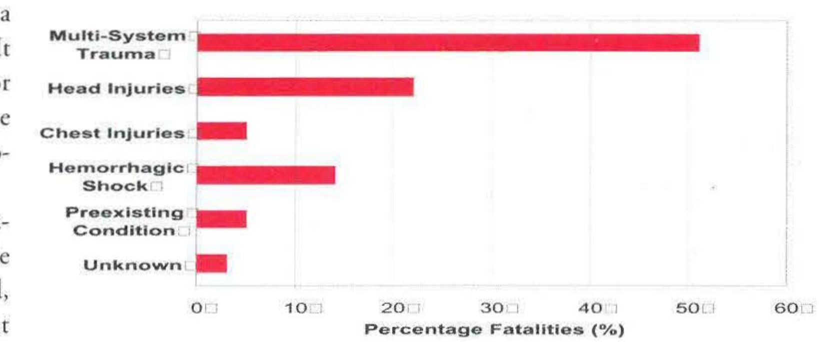
For decades, work has been performed on human injury from blunt trauma in the automobile field. Simulated automobile crashes are performed, and the response of the dummy is taken to represent the response of a human in that crash scenario. This dummy response may be used in an injury model to assess the risk of injury for that crash scenario.

The tools used in the automobile industry, however, may not be directly applicable to mine blasts for two reasons. First, automobile crashes and mine blasts are substantially different physical phenomena. While both automobile crashes and mine blasts may involve blunt head and chest trauma, mine blasts may have substantial shock wave effects, burns and other blast phenomena. Second, the events may occur on significantly different time scales. Injuries in mine blasts may occur 10 to 100 times faster than those in automobile crashes. These timescales have an effect on dummy response, and the timescale of mine blast injuries may be outside the validity of the injury models used in the automobile industry. So, tools used in the automobile industry must be adapted for use in mine blast testing to effectively assess the of risk injury while wearing protective ensembles.

Another important element in the effective design and evaluation of protection from injury is the epidemiology of the occurrence of those injuries in the field. Initial efforts to categorize injuries from humanitarian deminers (Landmine 2000) have identified the most significant injuries from mine blasts. Epidemiology, however, is a moving target, and future efforts to categorize ongoing injuries and their causes are crucial. For instance, the use of protective features may change the types of injuries experienced and could warrant changes in the focus of injury protection. A clear example of this case came with the widespread use of automobile driver-side air bag restraints. Use of such systems resulted in a substantial decrease in fatal head and thorax trauma, but it also led to an increase in the importance of debilitating leg injuries.

The types of injuries encountered in a number of demining incidents have been summarized in a groundbreaking report (Landmine 2000) as shown in Figure 3. Fatal injuries include blunt trauma to the head and chest, including blast lung, shock and

Fatal Injuries Sustained in Demining Incidents (Landmine 2000) Figure 3



multi-system trauma. Blast injuries may also include blast-induced trauma to hearing, burns and trauma from whole body translations with injury patterns similar to falls. To provide a realistic assessment of injury from mine blasts, all of these injuries must be included in the injury risk model.

Simulated AP Mine Blast with Hybrid III Surrogates Figure 4

Simulation of a realistic test condition is especially important in mine blast testing. A high-speed photograph of a simulated mine blast with two dummies is shown in Figure 4. The force on a human chest or head is related to the pressure from the blast waves. Since pressure falls as the inverse cube of the distance from the blast, the dummy position in the blast is vitally important in a realistic simulation. A field survey found that 91 percent of demining blast incidents occur with the victim within one meter of the mine (Landmine 2000). It is clear, however, that close enough to a large mine blast there may be substantial injury using any PPE. So, a balance must be maintained between the desire for test realism and the desire to evaluate the worst case in mine blast injuries.

Modeling the mine blast itself is a complicated issue. Nominally identical mines may have widely different behavior, and blast characteristics may change considerably, depending on soil and environmental conditions. Also, real mines may be difficult to obtain in quantity and to handle safely. To develop an objective test procedure, we want a test condition that is realistic yet repeatable—a balance that limits the number of tests and cost necessary to effectively characterize the performance of protective equipment. This argument suggests that mines should be simulated with a relatively well-characterized plastic explosive and should be implanted in a well-characterized soil. Several blast energies may be used to simulate the range of energies expected with actual mines. The selection of simulated mine blast energy should build on ongoing efforts to correlate blast properties of actual and simulated mines (Bergeron 2000).

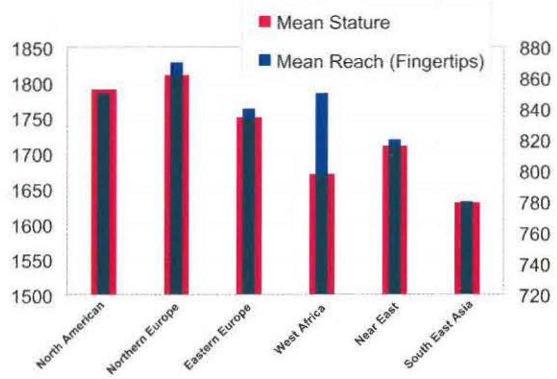
Hybrid III 50th Percent Male Dummy Figure 5

c/o First Technology Safety Systems

Several dummies exist that may be appropriate for mine blast testing. One widely validated dummy that may be particularly useful in estimating the risk of frontal blunt trauma is the Hybrid III dummy shown in Figure 5. The dummy pictured is the size of an average U.S. male, but scaled dummies exist for the small females and large males. Used in automobile crash testing, this dummy is widely validated in frontal blunt impacts for both head and chest injuries. It may be positioned using articulated joints. The Hybrid III may be instrumented with accelera-tion-sensing and force-sensing transducers. Though the dummy does not have a completely biofidelic response, the data from these transducers may be used with accepted injury thresholds and risk functions to determine the risk of injury in a given test condition.

As changes in anthropometry may change risk of injury, for an accurate response, the dummy selected should be representative of the population modeled. Worldwide anthropometry of the average male is shown in Figure 6 (Jurgens 1990). If the distance of the body to the mine when demining is taken to be roughly proportional to the mean reach (arm length),

Selected Worldwide 50th Percentile Male Stature and Reach Figure 6



the average Southeast Asian male is approximately 70 mm closer to the blast than the average North American male. This distance may substantially increase the risk of head or thorax injury in demining for the average Southeast Asian male deminer. As there are large numbers of mines in West Africa and Southeast Asia where the people have relatively short arms and/or are of small stature, the small Hybrid III dummy should be incorporated into mine protective equipment testing.

To summarize, essential elements in the development of a procedure for evaluating the risk of injury while wearing demining protective equipment are

- A robust dummy with established and applicable injury criteria positioned in a realistic manner in positions representative of demining (i.e., kneeling, prone, standing, etc.).
- Robust instrumentation–data handling consistent with the response.
- Accurate positioning–distance to mine must be consistent and quantifiable.
- Repeatable, quantifiable threat (mine) with fixed burial and soil characteristics.

Each of these elements acts to provide an objective criterion for injury risk while ensuring that the resulting criterion is as applicable as possible to the conditions experienced in the real world.

Existing Human Injury Criteria

Preliminary tests were performed using dummies with protective ensembles and simulated mines. The mines were plastic explosive with 200g C-4, 100g C-4 and 50g C-4. These devices were found to be comparable in blast energies to a wide range of existing mine types (Bergeron 2000). The dummy used was a Hybrid III 50th percentile male dummy or equivalent.

From the database of existing injuries, the types of injuries evaluated should be blunt head trauma, blunt neck trauma, blunt thorax trauma, blast lung, blast-induced hearing damage and burns. Blunt injuries can also evaluate the potential for "fall" type injuries caused by whole body displacement from blasts. All of these injury types except burns were evaluated in the preliminary test series.

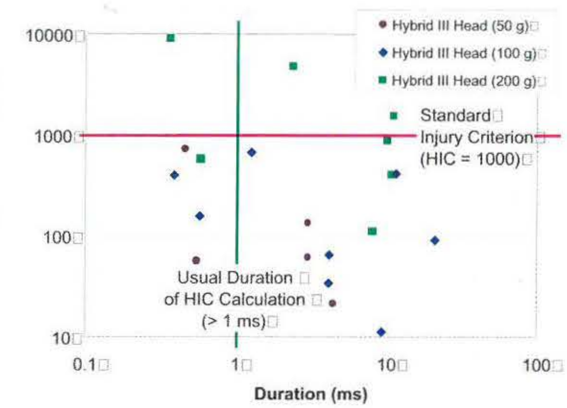
Blunt Trauma Head Injuries

As discussed above, fatalities from head injuries are very significant in mine blasts. These injuries may be caused by direct blast impingement on the head. One simple surrogate for the risk of head injury from force experienced by the dummy head is the peak acceleration at the center of the dummy head. This surrogate has the advantage of being easily measured, and existing injury criteria use this measurement.

One injury criterion commonly used with the Hybrid III dummy head/neck complex in frontal impacts is the Head Impact Criterion (HIC) for concussive head injury (Versace 1971). HIC includes the effect of head acceleration and duration; a HIC value of 1000 is specified as the level for onset of severe head injury. Physically, HIC predicts that large accelerations may be tolerated for short times. HIC is based on human cadaver and animal impact data with durations that are usually one millisecond or greater.

HIC values obtained in mine blast testing are shown in Figure 7 for mine blast strengths of 50g C-4, 100g C-4 and 200g C-4. Several tests with 200g C-4 showed potentially injurious levels of HIC, one near a value of 10,000, which is presumably a fatal injury. For several tests in this series, however, the duration of the acceleration peak was substantially shorter than the usual value of HIC duration (> one millisecond). This result suggests that the data on which HIC is based must be reevaluated for use with mine blasts and that the resulting injury model must be validated with a physical injury model.

HIC vs. Duration for Surrogate Mines with Hybrid III Dummies Figure 7

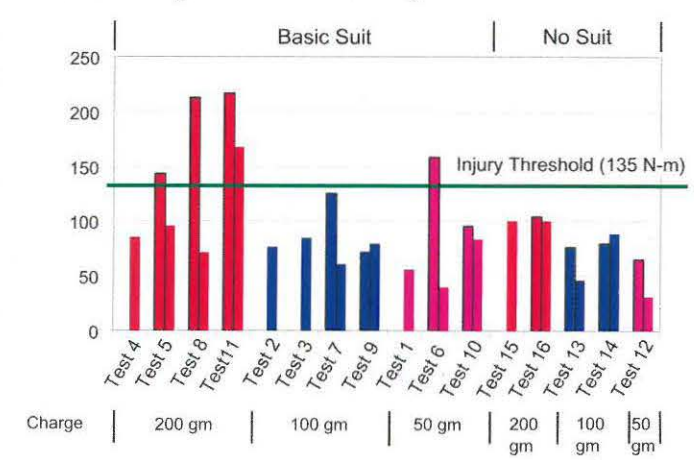


Blunt Trauma Neck Injuries

Neck injuries from blast trauma are possible owing to different rates of acceleration of the head and chest under blast loading. Physical trauma to the neck may be evaluated using the neck force transducers that may be incorporated into the Hybrid III dummy. Barring local damage of the neck itself, the dynamic impulse in the neck must be transmitted through the relative motion of head and chest. It is likely that this transmission of force is relatively slow when compared to the impact of the blast wave. This type of injury likely is similar in rate to impact neck injuries that have been studied in automobile safety tests.

One available injury criterion is based on the bending moment necessary to flex or extend the human neck. For extension, the human injury tolerance is 135 N-m bending moment. In Figure 8, the neck extension moment injury for several tests in the preliminary series is shown. Several tests in this series

Neck Extension Injury Criterion for Surrogate Mines with Hybrid III Dummies Figure 8



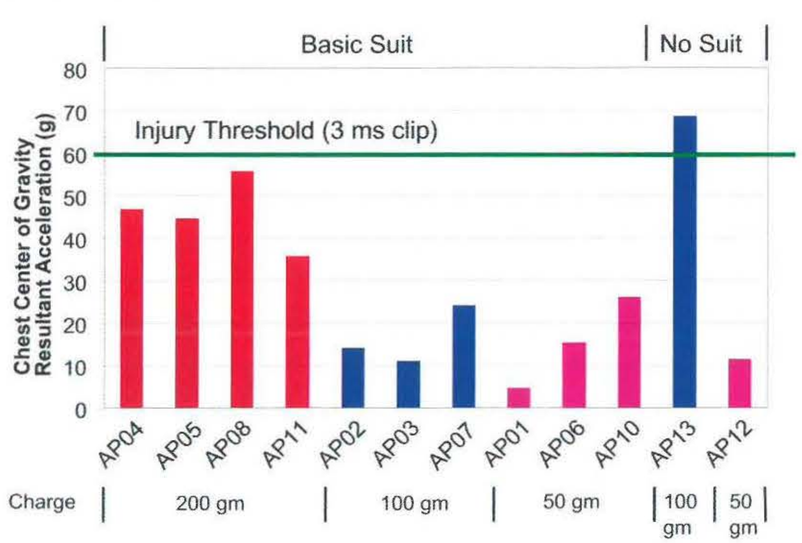
with protective helmets and suits showed potentially injurious levels of neck bending. All but one test that exceeded the injury threshold had the largest simulated mine (200g). The 50g test that showed injurious neck moments may be attributed to a loose Hybrid III neck for that test. Paradoxically, the use of a protective suit and helmet generally resulted in higher neck moments than when no protective equipment was used. This tendency likely is the result of the increase of surface area exposed to the blast when using the protective gear.

Blunt Trauma Thorax Injuries

The blast pressure wave and following pressure wave from the detonation of a mine have the potential to produce severe blunt trauma to a human thorax in proximity to the blast. Mertz and Gadd (1971) developed acceleration injury criteria for blunt trauma to the human thorax. This injury tolerance is 60g limit over a three ms duration. As with the head, acceleration may be taken as a proxy for the global force experienced by a thorax.

Representative chest accelerations from the preliminary test series are shown in Figure 9. As expected, the most severe chest accelerations occurred with no protective suit while the least severe occurred at the lowest level of mine blast (50g) with the protective equipment. This injury criterion does not include other possibly significant effects, such as chest compression injuries or blast lung injuries. However, these factors may be included using other measurements.

Blunt Chest Injury Criterion for Surrogate Mines with Hybrid III Dummies Figure 9



Blast Overpressure Injuries

There is a substantial risk of blast overpressure injuries, either blast lung or blast-induced hearing injuries, when at a close distance to AP mine blasts. However, the usual instrumentation of the Hybrid III dummy does not include any assessment of the effects of blast overpressure, either in the head or the chest. So, in preliminary testing, a pressure sensor was mounted on the surface of the chest to evaluate the potential for blast lung injuries, and another pressure sensor was mounted in the head at the location of the ear to evaluate the potential for hearing damage. The evaluation of blast wave injuries is important since addition of protective equipment for the thorax may exacerbate blast overpressure injuries.

Pressure profiles seen in the preliminary testing are similar to a typical ideal shock wave with a nearly instantaneous rise to peak pressure with exponential decay. Peak external pressure vs. duration for the thorax is shown in Figure 10. This data is compared with the classic threshold, one percent fatal, and 50 percent fatal free field curves taken from classic work by Bowen *et al.* (1968). While several of the tests with 50g and 100g C-4 show potential lung injuries at the threshold level, only the 200g C-4 simulated mines show greater than one percent fatalities on this scale.

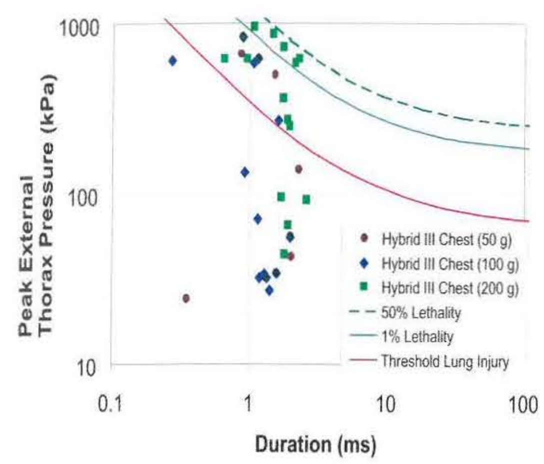
Future tests should incorporate additional pressure sensors in the thorax and head to minimize the potential for spurious pressure results. In addition, as the injury criterion used is a free field blast value for plane waves, an assessment should be made of the effects of differences between the ideal blast wave and local blast shock for AP mines.

Burns

As mine blasts involve explosive deflagration, there is a significant potential for burns close to mine blasts. The mechanism for this injury is rapid radiant and convective heat transfer to the skin. Predictive criteria exist for such flash burns; in 1960, the Naval Materials Laboratory developed a skin simulate for evaluating injuries caused by thermal insults (Derkson 1960). The technique uses a thick plastic resin with an embedded thermocouple. The temperature output of the thermocouple was correlated with human injury 120 mm below a living skin surface. A temperature of 44 degree celsius was derived as the threshold for such transepidermal injury.

In future tests, thermocouple sensors should be embedded in the dummy skin at the thorax, head and extremities to determine the risk of thermal injuries. This method is especially useful in the unprotected

Blast Pressure Measurements vs. Free Field Blast Lung Overpressure Injury Criteria
Figure 10



reference tests to provide a baseline for the comparison of the effectiveness of the protective ensemble for burn prevention.

Conclusions

Mine blasts are forceful events for which there is significant risk of injury, even while wearing protective equipment. To provide the most effective yet practical protection, a procedure must be developed to objectively and systematically evaluate protective demining equipment. Such a procedure is proposed in this study.

To avoid long development and high costs associated with the development of a completely new test procedure, this procedure builds on techniques currently used in the automobile industry to evaluate risk of injury from blunt force trauma in automobile crashes. The technique includes the use of Hybrid III dummies in testing with injury criteria adapted from accepted injury risk tolerances. Mine blasts are simulated in repeatable conditions for the rapid and inexpensive evaluation of a wide range of blast conditions.

Injuries modeled in this procedure include blast trauma to the head and chest, neck injuries, blast lung and blast-induced hearing damage and thermal injuries. For these injuries, existing injury criteria may be used with the Hybrid III dummy or injury criteria can be adapted for use with the Hybrid III dummy.

Preliminary tests have been performed that suggest the need for augmented instrumentation and validation using an appropriate physical injury model. These tests suggest that AP mine blasts may be injurious or fatal even with protective headgear and body armor. Further work is needed to characterize the robustness, repeatability and applicability of this promising technique for the evaluation of personal protective systems for demining. ■

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THE FACTS ON PROTECTION NEEDS IN HUMANITARIAN DEMINING

by *Andy Smith*, Consultant

Eye injury is common and easy to avoid.
Photo c/o Andy Smith

When assessing protection needs, my approach has been to determine what the risks are, what injuries result and then decide how to minimize these risks and protect against any residual danger. I also bear in mind that there is no point in prescribing an action or a garment that will not be used.

Though this method may be practical, it is not an approach endorsed by the protective equipment industry, which seems to prefer to base their assessment of risk on experimental data and a scale of injury used in the automobile industry. If the injuries they commonly predicted were accurate, all of the deminer victims I know would be dead. Most of them are at work.

Anyone considering this matter objectively should bear in mind that deminers do not want to wear any equipment that is uncomfortable, heavy, restrictive of movement or thought to be unnecessary. Demining program managers do not want to buy equipment that will not be used or is expensive to purchase and replace. They also are aware that demining incidents are extremely rare. I believe that severe incidents occur at the rate of one per 25-30 years of actual demining experience for each deminer. This statement ignores the fact that some groups have more incidents or work in more dangerous areas than others, but it does explain why most deminers have never seen an incident.

The following paper draws on information derived from five years of field research and from an intimate knowledge of the incident data in the Database of Demining Incident Victims (DDIV). The DDIV stems from my work during 1998 and 1999 for the U.S. Army CECOM NVESD Humanitarian Demining research initiative. It covers all recorded explosive incidents that have occurred while demining in Angola, Mozambique, Cambodia, Bosnia-Herzegovina, Laos and Zimbabwe. It also covers all the usefully recorded incidents that occurred in Afghanistan (1997-99) and those made available from Kosovo. It does not include details of civilian incidents and injuries. Often with considerable detail about the circumstances surrounding an incident, the records provide a reference for an informed analysis.

The DDIV has been accepted as an authoritative resource by GICHD in its work advising the revision of UN standards for HD. The DDIV is available on CD.

Threat activities

There are many opinions of what constitutes the greatest threat in demining. Using the DDIV as a data resource, it is possible to reduce the perceived threats to those that have a real manifestation. The "threats" are listed in terms of incident types and frequency.

Type of incident	*Number of victims*
Excavation	119
Missed-mine	85
Handling	32
Victim inattention	25
Detection/tripwire	18
Survey	16
Vegetation removal	12
Other	10
Demolition	7
Detection	6

One can see that "excavation" is the most frequent incident to occur. The second most likely type is a "missed-mine"; it involves a deminer stepping on a device missed during clearance. The essential difference is that the first is deliberate (the detector reading must be exposed by excavation) while the second is accidental (no one intended to miss the mine). In the first case, the victim is doing what must be done; in the second, he is the victim of someone else's mistakes.

Injuries Sustained

In the DDIV, injuries likely to be life-threatening to require surgery or result in permanent disability are rated as severe. All others are rated as minor.

For the whole database[2] the following injuries are recorded:

Face/head/neck
Severe eye 60, minor 37
Severe face 19, minor 100
Severe head 17, minor 16
Severe neck 5, minor 23
Total: 101 severe injuries

Hand/arm
Severe hand 34, minor 84
Amputation of hand 8
Amputation of finger 26
Severe arm 25, minor 66
Amputation of arm 13
Total: 106 severe injuries

Leg/foot
Severe leg 40, minor 94
Severe foot 17, minor 10
Amputation of leg 63
Amputation of foot 9
Amputation of toes 1
Total: 130 severe injuries

Body/trunk
Severe body 13, minor 36
Severe chest 18, minor 37
Severe genital 11, minor 5
Total: 42 severe injuries

The table reveals that there are more severe lower limb injuries than any other. What is not immediately obvious is that the most common type of incident, "excavation," rarely involves any lower limb injury. This fact is explained because lower limb injuries tend to be disproportionately severe.

Devices Involved

I am defining the threat as the mine(s)/devices most commonly occurring in recorded incidents in any one theater and omitting the AT mine threat. The DDIV includes records of two incidents involving an AT mine, both were fatal. Such cases being rare and seemingly impossible to protect against, I have left them out of this analysis.

The Blast Mine Threat

Afghanistan – PMN (240g TNT) mine featured in 62 injuries.

Angola – PPM-2 (110g TNT) mine featured in 12 injuries (PMN in six).

Bosnia-Herzegovina – PMA-3 (35g Tetryl) mine featured in seven injuries; the PMA-2 (100g TNT) mine featured in five injuries.

Cambodia – PMN-2 mine featured in at least 21; the "minimum metal" mines Type 72 (a or b) (51g TNT) featured in 13; and the M14 and MD82B (27/28g) featured in eight (total of 21 minimum metal mines).

Iraq – the PMN (240g TNT) mine featured in five injuries.

Laos – none recorded.

Kosovo – the PMA-two mines featured in four injuries.

Mozambique – PMN (240g TNT) mine featured in 14 injuries.

Zimbabwe – R2M2 (58g RDX/WAX) mine featured in 10 injuries.

In half of the countries, the PMN and/or PMN-2 represent the largest AP blast threats.

The Fragmentation Mine Threat

Afghanistan – POMZ (75g TNT) mine featured in 10 fragmentation injuries.

Angola – POMZ (75g TNT) mine featured in one fragmentation injury.

Bosnia-Herzegovina – PROM-1 (425g TNT) mine featured in 17 (all) fragmentation injuries.

Cambodia – POMZ (75g TNT) mine featured in one fragmentation injury.

Iraq – Valmara-69 (450g Comp B) featured in three injuries (PROM-1 also featured in two of these).

Kosovo – no fragmentation injuries are recorded (still waiting for data).

Laos – a mortar featured in the only recorded injury.

Mozambique – OZM-4 (170g TNT) mine featured in seven or eight fragmentation injuries.

Zimbabwe – none recorded.

The PROM-1, OZM-4 and POMZ represent the greatest threat (in that order), but the PROM-1 does not feature in the data for Cambodia, Afghanistan, Laos, Kosovo, Zimbabwe, Angola or Mozambique. Of those countries, it is known to be common in Kosovo.

The Ordnance Threat[3]

Afghanistan – a fuse featured in nine (of 12) ordnance related injuries.

Angola – no ordnance related injuries are recorded.

Bosnia-Herzegovina – a grenade featured in the only ordnance related injury recorded.

Cambodia – a fuse featured in four (of four) ordnance related injuries.

Iraq – no ordnance related injuries are recorded.

Kosovo – no ordnance injuries are recorded (still waiting for data).

Laos – phosphorous from an inadequately destroyed mortar featured in the only recorded injury.

Mozambique – a fuse featured in the only ordnance related injury.

Zimbabwe – no ordnance related injuries are recorded, but AP mine fuses featured in two recorded injuries.

Fuses are the most common cause of UXO injury with grenades being the next most common.

Reducing Risk

Most practical people accept that there are two ways to reduce the risk of severe injury in an incident. The first is to avoid the incident. The second is to provide effective protective equipment to limit any injury that occurs.

Avoiding risk can be achieved by revising the techniques used or by enforcing the application of operating procedures known to be safe. The DDIV recorded 82 incidents where a primary cause was "management inadequacy"—usually the failure to provide appropriate equipment or training. A further 190 incidents have "field control inadequacy," recorded as their primary cause. In these cases, deminers were not working as directed by management, and their errors were not corrected by management. Often they *were* obeying their field supervisors! These listings show that more than 82 percent of incidents may have been avoidable if appropriate controls were in place. Even allowing for revision downwards, this point illustrates that attention paid to improved management at all levels could be an effective way to reduce severe injury.

When everything has been done to avoid an incident, provision must be made to protect against any residual risk. The initial problem with this method is that it is impossible to protect against the worst mines. Bounding fragmentation mines are reported to spread fragments at velocities up to 1,200 m/s; a speed more than twice the size most body armors are capable of withstanding and four times the size the best visors are capable of withstanding. Deminers who trigger a mine at close quarters invariably die whether or not they were wearing protection. The answer is to try harder to avoid that risk. Strategies for this approach exist, such as cutting undergrowth with protected machines, avoiding render-safe procedures using makeshift clips (a risk revealed by the DDIV) and generally keeping the deminer away from the threat.

The most common activity at the time of an incident is "excavation" of a detector reading. This activity must be carried out, and explosions have occurred when no "mistake" was attributed to the victim. The "duty of care" of an employer requires that the deminer be protected appropriately when he is working as directed on a required task such as this one.

The second most common incident involves stepping on a "missed-mine." Missed-mine incidents indicate that clearance has not been effective. These types of incidents should never occur. Some time-served groups have not had any missed-mine incidents; others have had many. This fact implies that it is possible to work in a way that avoids them. Incidentally, there is no evidence of a greater risk of missing a mine when demining in areas with minimum metal mines. In the vast majority of missed-mine incidents, the mine was a PMN, PMN-2 or PPM-2, all of which have a large metal content. Even in Cambodia where minimum metal mines are relatively common, as many deminers have stepped on PMN-2 mines as on all minimum metal mines combined (T72, M14 and MD82Bs). The evidence in the DDIV suggests that the best defense against the missed-mine risk is to avoid them by using better working methods and adequate supervision.

The next most common incident occurs when handling a device, sometimes one believed to be safe. Better training could alleviate ignorance, and some groups could avoid the risk altogether by not allowing devices to be handled. Practical protection is impossible without introducing a barrier so thick that the device becomes too remote for tactile feedback. Avoidance is the only open strategy.

The next most common incident is recorded as "victim inattention." This type covers times when deminers accidentally fall over a mine, walk into an uncleared area or otherwise behave in a thoughtless manner. While in some cases close supervision and rigorous training might have prevented the incident, it has to be accepted that moments of inattention will occur. It is impossible to predict what an incident like this will involve. The only practical protection seems to be that which is used for other incidents.

The next most common incident is recorded as "detection/tripwire." This type covers incidents where a tripwire was pulled or a deminer trod on a device while clearing land (the area was not declared "clear" at the time; so, the mine was not technically missed). Failure of equipment and careless use of the detector were the causes for these incidents. I believe that this type is another case where protecting the deminer would be best achieved by ensuring that the incident did not occur.

The next most common incident is recorded as "survey," which occurs when a survey is being made or when a mine is initiated in an area declared "free from mines" or "reduced" during a survey. Most accidents involve mines that were missed during the survey; so, improving the quality of survey would have prevented most of them. No practical way of protecting against the remaining risk is apparent.

The next most common incident is classified as "vegetation removal." These incidents involve pulling a tripwire while cutting vegetation or stepping out of the safe area while doing so. Both could be avoided by enforcing existing operating procedures or by using, where possible, mechanical means to cut the vegetation prior to manual demining. Given that the risk includes the fragmentation mine threat, no practical protection against it is possible.

The next most common incident classification is "other." This type covers a range of isolated incidents with little in common. Several of the incidents involve the apparent sickness of the victim, which may be something spotted by the field management.

The next most common incident classification is "demolition." This type is rare and happens when an explosive injury occurs while charges are being prepared or laid for the demolition of a device(s) already located. These incidents have included fragmentation mines. No effective protection could have been made available for some of these incidents, and at least some were caused by the victim breaching operating procedures. It seems likely that improved training is the only practical way to reduce the number of these incidents and the severity of damage to the vicitms.

"What can often happen while a deminer is working as directed with the tool he is issued." —Andy Smith, describing the cause of the above scene.

Photo c/o Andy Smith

Of all the classifications mentioned above, the only incident that occurs even when a deminer adheres to his training and instructions is "excavation." This type is also the most common incident. For these two reasons, I believe it should provide the benchmark for protection needs.

Protection While Excavating

To protect a deminer against incidents that occur when excavating, we must be aware of the position he is in and the areas of his body most at risk. Despite the claims of some ill-informed managers in the industry, the data in the DDIV clearly illustrates that almost all deminers work in a kneeling or squatting position while excavating. This news is good for the deminer because he avoids the whiplash acceleration injuries that have been associated with deminers in a stationary position with their heads only a few centimeters from the blast origin. The exploding device is almost invariably directly in front of and below his body and head. Often, his hand is above or alongside the device.

Severe (disabling) Injuries Recorded While Excavating

Face & neck = 54 severe injuries
Upper limb = 51 severe injuries
Lower limb = 7 severe injuries
Trunk/Body = 10 severe injuries

The difference in size between the injuries to the upper limbs and head (51-54) is statistically insignificant in a sample of this size. The drop to seven for lower limb injuries is significant, as it illustrates the way that a fragment cone rises from a seat of initiation and the core of it often misses the legs (minor leg injuries were more common - 36). The drop to 10 for trunk/body injury is also significant, illustrating clearly that the main torso is not at the same degree of risk as the upper limbs and the head. Several of the severe body injuries resulted from the tool, or part of it, hitting the body.

Face and Neck Protection

Despite the fact that some form of eye protection was issued, it was not worn in almost half of the recorded blast mine incidents. Eye injury accounted for 97 of the 236 blast mine victims in the database (more than one in three).

Eye protection issued varies from industrial safety spectacles to 5mm polycarbonate visors. Safety spectacles were issued to 25 percent of the victims in the DDIV. In 33 percent of the cases, 3mm visors were issued, and these visors sometimes shattered (there were 19 severe eye injuries in excavation incidents over two years in that theater alone).

Visors made of 5mm thick untreated polycarbonate sheet that cover the face have been used by most professional groups (MAG, HALO Trust, NPA Mozambique & Angola, MgM, Koch MineSafe, MineTech, INAROEE, etc.) for some years, and their use is spreading. Some of the visors are short and attach to helmets, all too often leaving the wearer's throat exposed (especially from below when kneeling). Others are long and worn without helmets. When worn properly, these offer some protection to the throat when kneeling and looking down.

I have tested 5mm untreated polycarbonate visors in over 40 blast tests using AP mines. They have not failed catastrophically, but a 5mm visor did break in two in one recorded incident. In one test, the material was penetrated by a steel fragment placed in the earth covering the mine. In several further tests against POMZ fragmentation mines, the visor was not penetrated at all, illustrating the unpredictability of mines but also showing that 5mm polycarbonate does not guarantee protection to a deminer excavating an AP blast mine. A full-face visor made of polycarbonate is light enough for sustained wear (thousands of deminers use them) and is probably the best that can be provided until a lighter, stronger material is developed. This evidence suggests that 5mm polycarbonate full-face visors fixed in the "down" position should be the standard for facial protection while excavating AP blast mines.

Upper Limb Protection

It is unconventional to put hands and arms among the areas needing protection. However, the DDIV recorded 51 severe upper-limb injuries from blast mine detonations, including 14 amputations of fingers and hands and 10 of arms. These injuries are worse when the tool is short and used vertically. When the tool breaks into its component parts, deminers have been struck in the chest, upper arm and face with severe consequences. At least five deminers died after their hand-tool failed and fragmented in a blast.

There is also evidence in the DDIV that hand and arm safety can be enhanced by using hand-shields and sensible manufacturing constraints that keep a tool in one piece. For example, in at least eight prodding incidents with a simple tool made in Africa, the tool blade curved and the handle and blade stayed together. In none of these incidents was the deminer injured by his tool.

The evidence from the DDIV supports my belief that

- To prevent hand injury when excavating, tools should be designed so that they are easiest to use at a low angle to the ground; and
- To reduce hand and arm injury, tools should be designed to stay in one piece, should be long enough to keep the deminer's hand at least 30cm from the blast and should incorporate a flexible blast shield whenever possible without reducing utility.

Examples of such tools exist and are available commercially.

Body Protection Against Fragmentation

Protection designed to reach a STANAG V50 of 450m/s (current U.N. standard) has proved less than adequate against bounding fragmentation mines. Fortunately, fragmentation mine incidents are rare outside Europe, and there are no records of a bounding fragmentation mine incident occurring while excavating.

Body Protection Against Blast

The DDIV recorded 14 deminers dead as a result of blast mine detonations. Five of these victims were wearing frag-jackets of some kind, but all five were not wearing head protection (or not wearing it properly). Additionally, four of these involved severe head-injury; the fifth deminer was squatting and stepped on a mine so he suffered severe lower body injury. The frag-jacket did not appear to have "failed" in any of these cases. In excavation incidents where armor was worn, it did not fail; thus, the DDIV provides evidence that the STANAG 450m/s current standard of body protection is sufficient against the largest blast-mine threat (240g TNT) at a distance of 30cm.

However, a STANAG V50 of 450m/s is no measure of blast protection. A blast mine detonation is a significantly different kind of threat, and the materials used to protect against it may not have the same fragmentation resistance despite being more effective against a blast mine detonation. An example of this situation is the low cost, flexible ballistic Aramid; it retains its integrity in a blast better than Kevlar, but it has a much lower V50, weight for weight.

As the data in the DDIV shows, the armor currently issued is not always worn. Deminers tell me that because it is heavy and uncomfortable, they feel that the bulkiness of the gear may increase their chances of making a mistake. This assertion explains why there has been a general move away from flak-jackets toward frontal "aprons." Some of the aprons hang loose while others are strapped firmly to the body. Some aprons have a V50 as low as 380m/s; others exceed 450m/s. The only type to fail in my tests had the higher V50, but it was made up of discrete panels that the blast separated. Conversely, the one-piece apron with a lower V50 performed well in seven tests and in at least 15 real incidents.

The evidence shows that the need for body protection may not be a high priority, but it is desirable. It is even more desirable if it is comfortable enough for a deminer to wear. Simple blast resistant frontal aprons have proved adequate to protect an excavating deminer in real incidents and comfortable enough to be worn without protest. Thus, the evidence suggests that deminers should be issued frontal body and genital blast protection aprons (240g TNT at 30cm) when excavating.

No Protection Because of No Real Risk

There are a number of products available that offer protection against questionable risks. Facts suggest that these risks are so rare that deminers feel that protection against them is unnecessary.

There is no evidence among the data for over-pressure internal injuries ("thoracic disruption") resulting from an AP mine. The evidence in the DDIV proves beyond reasonable doubt that this "threat" is more commercially convenient than real. Presently, there is no evidence to suggest that blast-proof boots have reduced injury. Current evidence suggests that wearing blast-boots when stepping on a blast mine containing significantly more than 50g HE may actually worsen the level of severe injury. Also, the only

"No protective equipment I have seen used in humanitarian demining can guarantee protection against a bounding fragmentation mine." —Andy Smith

Photo c/o Andy Smith

boots with some effectiveness against the smallest mines include a stand-off of at least 10 linear cm in their design. These boots would be impractical in the mined environments I know. There is no evidence in the DDIV that wearing a helmet or a back-panel to body armor has ever significantly reduced the severity of an injury.

Protection against hearing loss is sometimes suggested. While there have been many claims of hearing damage from single blasts in Afghanistan, this case has not appeared in other theaters. The compensation system in Afghanistan claims for low level and unverifiable ear damage (deminers could still return to work). Excluding Afghanistan, the DDIV lists only one claim of severe hearing damage resulting from a single blast (close proximity to a large device).

Practical Approaches to Meeting Deminer Protection Needs:

- Reducing the number of incidents that occur, and
- Reducing the severity of injury when an incident occurs.

The first can be pursued via changes to working methods and improved supervision and management. This approach is likely to be the most effective. The second can be pursued via the provision of Personal Protective Equipment (PPE) appropriate for use at times when risk cannot be avoided.

Practical PPE That Could Reduce the Severity of Incidents:

- Eye protection with a STANAG V50 equal to that offered by untreated 5mm polycarbonate (about 280m/s). This equipment must be in good condition and not reduce clarity of vision by more than 10 percent;
- Hand-tools that are fit for a purpose and are designed to minimize the risk of adding to injury; and
- Comfortable frontal blast protection (against 240g TNT at 30cm) for use when excavating. The inclusion of a collar that overlaps the visor and closes any access to the throat in a blast is desirable.

Some groups already do most of the above. A few of the organizations have done so for many years. This report provides evidence that my suggestions are practical, and the DDIV provides evidence that they are needed. ■

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[1] These activities are defined in detail in the DDIV.

[2] Statistics are based on the April 2000 release of the DDIV.

[3] Submunitions with Anti-Disturbance fuses, frag-jackets and shaped-charges are a separate risk that requires a distanced approach and specialized SOPs. They have not been featured in recorded incidents.

One Last Appeal

Please, let us not spend mine-clearance money on unnecessary expensive equipment. Let us not load down a deminer with equipment that he will discard as soon as our backs are turned. Please, let us not ignore the facts just because they disturb our quest for profit.

CONQUERING THE INSURMOUNTABLE

The Canadian Center for Mine Action Technologies Advances the Technological Realm of Demining

by Stephanie Schlosser and Virginia Saulnier, MAIC

The Canadian Center for Mine Action Technologies (CCMAT) is a partnership of resources from the Department of National Defense and Industry Canada. The Center is co-located with the Defense Research Establishment Suffield (DRES) at Canadian Force Base Suffield in Alberta.

CCMAT's mission is to conduct research and development of low cost, sustainable technologies for mine detection, mine neutralization, personal protection and victim assistance. The center also seeks to find alternatives to anti-personnel landmines and serve as an information hub on humanitarian demining technologies. CCMAT is a test and evaluation site for new ideas brought forward by the Canadian Industry and its partners.

After the CCMAT was established in August 1998, Dr. Denis Bergeron quickly assumed an active role within the center. Previously, Dr. Bergeron's background at DRES had directed his focus to the neutralization of landmines; however, his interest has since shifted to the protection of deminers against exploding landmines. During an interview with the Journal, Dr. Bergeron offered candid responses concerning CCMAT's main objectives, their current products and their vision for the future.

Communication Venues

Dr. Bergeron spoke extensively of the flowing web of communication present in the demining community, especially between Canada and the United States with respect to SOLIC and Fort Belvoir, Virginia, and the European demining organizations. "It's been excellent cooperation on that side [Fort Belvoir]. There's also quite a bit of cooperation with the European community… . There is a very frequent exchange of information, keeping each other aware [of] the progress." Maintaining open communication is vital to the advancement of demining technologies, as "there isn't enough money to try everything…and certainly you don't want to quench any of the ideas that are coming out. However, you have to be selective as to pursuing which ones will actually make a difference in the field."

Despite the traditional image of static think tanks and endless facts and figures, technology is a creative activity that only grows when one new invention spurs on the thought process of another developer.

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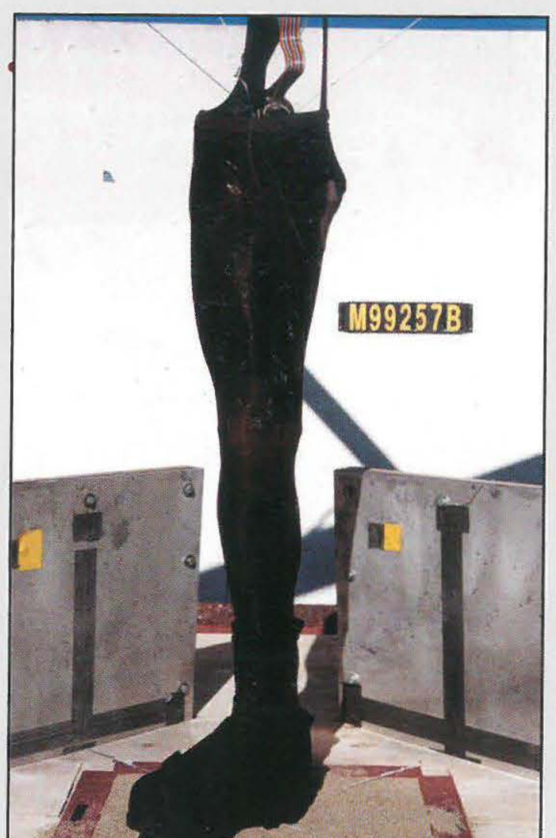
The Demining Technologies Information Forum

To reinforce the open exchange of ideas among the demining R&D world, one of CCMAT's newest initiatives is to start a Demining Technologies Information Forum (DTIF). With new developments in mine action technology as a major part of the CCMAT mission, a way to share those innovations is paramount to the center's success and effectiveness. There is a need among scientists, engineers and all R&D to advance demining technologies and to share information in an organized way. Some key players in DTIF would be the European Union, United States and Canada. The sharing of even the simplest idea to the most technologically complex will create an auger for advancements in mine action technologies that contributes to the world's efforts to remove landmines.

DTIF will be a forum for R&D people involved in technical demining and will be open to all countries, especially those with a funded R&D demining program. For DTIF to carry on its work in the most productive format, CCMAT has outlined several of its qualities. DTIF will keep the technology world updated on the state of funded research in national programs. Additionally, DTIF will develop meetings, workshops and a universally accessible web site, and employees will publish an electronic journal dedicated to R&D demining. DTIF will be implemented through the JMU/MAIC web site, through a demining technology journal, newsletters or other suitable publications, and it will conduct workshops on specific topics. The first conference was held in Ispra, Italy, in July 2000. Essentially, DTIF will succeed in supplying a medium conducive to the free sharing of technological theories, assisting the flow of uninhibited communication.



With the creation of the FSL, engineers and scientists can measure a human leg's reaction to an exploding mine.
Photo c/o CCMAT

New Technologies

As one of CCMAT's prime objectives focuses on innovative demining techniques, applying military countermine technology to humanitarian demining seems only logical. Therefore, the collaboration with other organizations assists CCMAT's attainment of this goal in addition to maximizing the efficiency of a combination of resources. Dr. Bergeron supports this objective, as "technology remains technology… the physics are what drives the [landmine] problem and what will drive us toward a solution." Although military countermine technology specifically applies to the speedy detection and neutralization of ordnance under combative conditions, the application of military intelligence to humanitarian demining demands attention. "[Deminers] can bring the technologies that would not fit the time schedule for countermine and use them in humanitarian demining," effectively demonstrating the potential benefits resulting from collaborative efforts.

The Frangible Surrogate Leg

Because most victims of landmines detonate the bombs when they step on them, the feet and legs are usually the first body parts to feel the terrible impact. In order to test safety equipment for deminers, CCMAT must have a tool to simulate the deminers' limbs and, therefore, give accurate readings on the effectiveness of a given tool. Hence, engineers and scientists invented the Frangible Surrogate Leg (FSL). The FSL is a particularly positive example of the demining community's coordinated endeavors. This new technology, developed by Australian scientists at the Defense Science and Technology Organization and the University of Adelaide, allows the center to facilitate the design, development and evaluation of new protective clothing and equipment for deminers.

The FSL is a precise reproduction of the human leg made with materials that react to a blast as human tissue would. "It has advantages over donated limbs…from people who have had gangrene or something, [because] those limbs have disease so the results are biased. If the subject is a twenty-year-old, there is a certain strength in the bone [as compared to a sixty-year-old]; therefore, in trying to compare tests …, you are not working from the same sheet." Consequently, the FSL's likeness to a human limb is what makes it so vital to deminers' safety. The bones are made of mineralized plastic, and ballistic gelatin represents the muscles.

After the FSL receives the impact from a simulated AP mine, strain gauges placed on the bones measure the load imposed by the blast, and an X-ray sensitive dye allows surgeons to use the CT scan for diagnosis. The CT scan produces a three-dimensional image that allows non-medical personnel, such as the designers of protective equipment, to interpret blast injuries and create better protective equipment. By understanding the physics of a mine blast, as it pertains to lower leg injury, equipment designers can better serve deminers in the field. The FSL can help with the evaluation of prototypes and new designs at their earliest stages.

The Spider Boot

An example of one of the benefits resulting from the application of the FSL to demining safety concerns is the Spider Boot. The boot, which is intended to protect deminers' feet if they should detonate a landmine, looks like a chic hiking boot on top of a tabletop-like platform complete with four "legs." The developers of the Spider Boot, Med-Eng Systems Inc. in Ottawa, worked with the help of a Defense Industrial grant to develop this foot-protection tool. By testing the boot, CCMAT fulfills its mandate to adapt military technologies for application to humanitarian demining.

The Spider Boot's futuristic look does not make it at all a playful toy or inventor's fluff. It is, rather, a potential life- and limb-saving piece of footwear. The idea behind the Spider Boot is that it keeps the foot at a safe standoff distance from the blast origin. The Spider Boot provides more protection than a conventional mine boot by deflecting away decaying blast waves and by absorbing the residual energy with the composite materials of the boot. Field trials at CCMAT have shown that the energy-absorbing materials in conventional boots cannot withstand the overpressure of the detonation.

As with any new piece of equipment, skepticism is bound to surface, but, as Dr. Bergeron stated, "People in the field are skeptical, and they should be because they're the ones whose lives are on the line. The equipment is there to protect [deminers], provided [they] use it in a certain manner." In addition, Dr. Bergeron asserted that demining organizations must not blindly purchase equipment for their employees, but research the benefits from proper use of the equipment and the consequences resulting from improper use. "That's part of the testing too, so you can provide people with an example," Dr. Bergeron acknowledged, referring to the testing of the FSL.

CCMAT's Vision for the Future

In conclusion, CCMAT's vision for the future must coincide with their current direction to position themselves to further improve deminers' personal protective equipment and clothing. Dr. Bergeron summarized, "I think what's important within CCMAT is that we are taking a step in the right direction, one that's improving a lot on the safety of [deminers]. … And, like anybody who works in this domain, you want to see the work that you do be put to good use. That's what we're hoping for. I think we are very much in line with meeting that goal. You always want to leave a legacy behind [and know] that you've done a good piece of work that's useful to people." ■

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During the past year, the CCMAT has carried out testing to evaluate the Spider Boot, a radically new foot protection system against anti-personnel (AP) mines.
Photo c/o CCMAT

Deminers, Manual Demining & Their Protective Equipment

In Cambodia, a deminer was working in the prone position and set off an anti-personnel type 72 Chinese tilt mine. The resulting blast went over his head and did not damage his exposed hands. The blast over-pressure sucked air and dirt into his helmet visor and punctured his eye, which recovered fully. This over-pressure problem was caused by an air gap between the helmet visor and his protective jacket. Within seven days a new visor was dispatched from the manufacturer to my specifications, tested and found to remove the air gap problem. As part of the daily safety checks carried out on deminers it is necessary to ensure that helmet and protective jackets are properly fastened.

A deminer kneels in his cleared lane.

Photo c/o MAIC

by Norman Stewart, Director Mine/s Clearance International

Introduction

There are many reasons that can be given for wanting to work in the field of humanitarian demining. Some of these reasons can come from the experience of living and working in mine-affected communities for periods of time. The results of a landmine explosion and the damage caused to humans have a devastating effect. This is especially true where children, unknowing of the danger, carry out normally accepted routines. On many occasions I have witnessed the effect first-hand, mainly on civilian casualties. People, usually relatives, trying desperately to reach victims in mined areas, have to be physically restrained to prevent them from becoming victims themselves.

Manual Demining

Understanding the basic safe and proven method of manual demining, gives an instant advantage in dealing with situations like those mentioned above. Manual demining has many advantages over other more mechanical interventions, many of which remain unproved. For instance, where mechanical access is restricted, a manual deminer may not experience this as a difficulty. When problems arise, information can be readily obtained from personnel. Through questioning, reasons for action can be discussed and studied, and plans can then be made for remedial action.

Training

Selecting and training of locals in affected countries has become the norm. This is successful when the training is carried out by properly qualified and experienced instructors. They have experience with the problems expected to be encountered in the selected country. The teams of manual deminers will only require basic equipment to enable them to carry out the tasks given to clear land.

To speed up the process of manual clearance, without a reduction in safety, requires extensive training of deminers. This ensures that the drills that are taught and the skills transferred produce confident, qualified personnel in the demining teams. These teams need to be continually monitored to ensure that the quality standards taught and practiced are maintained. With increased practice a natural process evolves within the teams, who with gained confidence, increase their capacity to clear land.

In some countries scrub results in a manual clearance problem. To produce the best detection capacity, it becomes necessary to remove scrub so that the metal detectors can be in close proximity to the ground. Scrub removal takes up to 80 percent of the time utilized to clear land and has to be removed before manual deming can take place. Mechanical scrub cutters that are available could help to reduce the time factor, and therefore, help to clear land quicker.

Training the Trainers

Selection and training of locals into mine-clearance teams in affected countries requires the supply of qualified and experienced instructors. These experienced instructors will be required to have an understanding of the local culture and a technical knowledge of the mines and associated unexploded ordnance that may be found in that country. It must be understood that a good base for training of expats has been the military engineering schools. Commissioned officers seldom gain this type of training, as they often become involved in the management of military programs, leaving their soldiers to deal with the clearance.

Military vs. Civilian Clearance Requirements

There is a big difference between military and civilian demining requirements, although the basic skills remain the same. The military requirement is to clear sufficient ground to permit movement of battle groups etc, and is known as breaching minefields. Casualties of an average of 15 percent from such military action are accepted. Protective equipment is normally worn by the military while carrying out such tasks.

Civilian requirements are quite different from those of the military. Cleared ground needs to be safe and accessible for production. To achieve "safe ground," it is necessary to search 100 percent of the mined area. Quality assurance needs to be applied to ensure that the clearance has been carried out effectively.

Protective equipment in the form of body armor and protective headgear should be issued to each deminer. In some countries, the lack of experience of some of the instructors results in them permitting deminers to crouch down to prod mines. This practice should be terminated. The correct position is prone and with the arms extended. Although not always comfortable, mats can be provided for comfort. Laying mats on the ground can also protect the deminers from sharp stubble.

Interpreters, Selection and Training

Selection of interpreters for ex-pat staff employed as instructors requires interpreters to have a good working knowledge of the instructors language. Time needs to be spent with interpreters to ensure that any instruction that may be given is fully understood. This needs to be carried out prior to training and selection of the locals. Experience gained in many countries provides a skill base. Combined with the correct selection process, male and female deminers will develop their skills at the hands of qualified and experienced instructors. Time needs to be set aside for testing and practice during training. When necessary, extra training during operations must be given when techniques have to be adapted to fit the requirements, of safety. Standard operating procedures and safety orders need to be fully translated, taught and tested.

Increasing the Skill Base

Opportunities should be provided to increase the qualified deminer's capacity and skills base. During operational deployment, each and every team member should be given the opportunity, under supervised conditions, to lead the selected team. Each team member is assessed on his abilities by a qualified specialist and awarded merit points. A management committee carries out a selection process to determine which personnel should be given further training.

Courses of training may include:

- Supervisors Course
- Team Managers Course
- Leadership Course
- Medics Upgrade Course

The aim of these courses is to provide, given time and practice, an indigenous capacity in the selected country.

Manual demining can be routine, methodical and requires extreme concentration. From experience and comparison, female deminers have produced more daily output than their male counterparts and are suited to the conditions required. All deminers and training programs can benefit from an organized methodology for training and deployment in the field, which should be combined with protective gear that is adapted to the deminers needs. ■

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Countering the Global Landmine Epidemic ...Through Basic Science Research

by Mark S. Rountree and LTC Robert M. Harris, M.D.
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Since their first use during the U.S. Civil War (Croll 1998), blast landmines have played a role in almost every armed conflict from the World Wars to the most recent limited skirmishes. Landmines are the epitome of the consummate soldier: always ready, never tiring. Mines are simple devices that can fabricate with little effort and from readily available materials. In Sri Lanka, numerous news releases covering the conflict mention a "Johnny mine" (Botsford 1997), which is a local term for an improvised explosive device. Manufactured mines can be inexpensive, costing as little as two dollars apiece. If mine laying operations ceased tomorrow, an estimated 100 million mines would remain in place throughout the world (United Nations 1994).

Burden

Landmine injuries have reached epidemic proportions in the Third World, affecting both combatants and civilians. From 1980-1993, the incidence of landmine related injuries doubled, resulting in an estimated 2,000 deaths or injuries per month (Rutherford 1997). Designed to maim rather than kill, landmine injuries can quickly overburden local medical services, creating shortages of medical supplies and lengthening the wait for treatment. Landmine survivors often require more surgical procedures than other war injuries, longer recovery times and their injuries rapidly deplete the limited blood supplies. Even with international assistance, many countries' emergency services are quickly overwhelmed, further escalating the morbidity and mortality rates for these and other injuries (Stewart 1999).

Landmines have a lasting effect on the indigenous population of affected countries in many aspects of daily life. By limiting access to agricultural areas, landmines may contribute to famine, forcing inhabitants to farm in mined areas, thus increasing the number of victims. For landmine amputees, the limited supply of adequate prosthetic devices can determine their level of dependence on others for support, further burdening the economy.

Personal Protective Equipment

While Personal Protective Equipment (PPE) will not be available to everyone in a mine-threat area due to the cost and shear numbers involved, individuals responsible for landmine clearance operations require protection in case of accidental detonation. During the early 1900s, soldiers attempted to fabricate protective AP mine footwear using common materials, such as lumber and rope (Croll 1998). Later, in the early 1950s, the U.S. Marine Corps developed a six-inch sabot attachment for combat boots while the Army evaluated protective shanks in the 1960s (Fujinaka, E. S. & MacDonald, J. L. 1966).

Commercially produced mine-protective footwear is currently in use, and its effectiveness is being highly touted by the manufacturers. However, recent testing has shown these boots are inadequate in the prevention of severe injury, and further research is necessary to facilitate future development of effective mine-protective footwear.

Testing

Until recently, the evaluation of anti-mine footwear tests involved little more than material properties testing utilizing surrogate metal limbs or wooden forms. Evaluation of protective capability was determined by the boots' ability to remain intact. These test fixtures had little or no correlation to human physiology or the injury producing mechanisms. Past evaluations were unable to correlate test results with actual human injury.

In the 1990s, work conducted at the U.S. Army Natick Research, Development and Engineering Center led to the development of new anti-mine footwear. Testing of this footwear began with laboratory material properties testing and ergonomic field trials during simulated clearance operations and then progressed into field trials utilizing surrogate metal limbs (Tijerino, & Hay 1999).

Mine Trauma Scoring System Table 1

Injury Assessment	*MTS*	*Injury*
No major injury	0	
Salvageable limb	1	Closed
	1A	Open contained
	1B	Open contaminated
Transtibial amputation	2	Closed
	2A	Open contained
	2B	Open contaminated
Transtibial/transfemoral	3	
Transfemoral	4	

Evaluation

While these tests produced valuable information, the actual mechanism of injury was not fully understood. To better define the injury process, the U.S. Army Institute of Surgical Research, Extremity Trauma Study Branch (USAISR-ETSB), conducted field trials in collaboration with the Aberdeen Test Center (ATC) and the University of Virginia's Automotive Safety Laboratory (UVA) (Harris, et al. 1999). Based on years of research conducted by the automotive testing industry and the capabilities of ATC, cadaver testing was conducted to better understand the pathophysiology of a blast landmine injury and if protection is feasible.

The purposes of the study were the biomechanical evaluation of blast landmine injuries and to compare the medical outcomes to the various levels of protection provided by several types of commercially available footwear. Recognizing the inapplicability of injury scoring systems such as the International Committee of the Red Cross's (ICRC) wound scoring system (Coupland 1992) and other civilian studies (NISSA, MESS, MESSI) (Bonanni & Lucke 1993) (McNamara, Heckman, & Corley 1994) in assessing blast injury severity of the lower limb, the Mine Trauma Score (MTS) was developed (Harris, *et al.* 2000). The MTS was devised to compare the severity of landmine events under different test conditions without relying on any physiological parameters in order to apply it to the cadaver model. The vast majority of landmine injuries in the field require either transtibial or transfemoral amputations (Coupland 1991); however, the scope of the MTS includes values appropriate to lesser degrees of injury. This range of values allows for the evaluation of any protective effect provided by the footwear (Table 1). In addition, the MTS may allow for future retrospective studies of actual deminer injury records for validation purposes.

The MTS uses the following definitions of the injury criteria: I) Closed injury: injury of the lower extremity that does not violate (lacerate, tear) the skin. The potential infective sequelae of injury are minimal even with underlying fractures compromising functional outcome. II) Open contained injury: any lower extremity in which the skin is breached (lacerated, torn), but little evidence of contamination is present. An example would be a laceration to the skin of a foot contained within an intact boot. By avoiding the gross contamination usually associated with mine injury, this group may sustain fewer secondary infective complications. III) Open contaminated injury: any blast mine injury to the lower extremity in which the skin is not only violated but the exposed soft tissue is visibly contaminated. This contamination may be from the soil, footwear debris or landmine fragments. IV) Salvageable limb: an injury in which the severity does not render primary amputation inevitable. V) Transtibial/transfemoral: when the area of injury extends into the proximal third of the tibia and the severity makes it difficult to determine

Boot Designs
Photo c/o Rountree, Harris

the level of amputation required at the initial treatment. Even when the extent of soft tissue damage does not extend above the knee, there may be insufficient tibial length or adequate soft tissue to fit a workable prosthesis. In this circumstance, every attempt is made to keep the level of amputation transtibial for functional reasons; however, revision to a higher level may be required at a later stage. An MTS value of definition three represents this category of uncertainty of the final level of amputation.

Explosive blasts create smoke and other flying debris that obscure much of the event. The ATC has modified flash X-ray technology, incorporating pulsed emitters with a scintillating screen and a high-speed camera for Cineradiographic evaluation of the tests. Capable of recording eight images at a rate of up to 100 million frames per second, the first X-rays of a landmine event were obtained at 250 µs intervals. These images have fostered a better understanding of explosive injury mechanisms.

Boot Strategies

Mine protective footwear strategies currently fall into three broad categories. The first is blast deflection that directs the blast away from the contacting limb (Wellco Blast boot alone). The second is standoff, which uses elevation (BFR), or off-axis detonation (MedEng), to distance the involved limb from the mine blast. The third method involves blast attenuation that utilizes materials that decrease transmitted energy through a change in their physical state or attenuate the blast by destruction of the boot (Wellco Over boot). For the cadaver testing, four commercially available mine-protective boots were evaluated. A standard issue U.S. Army combat boot (Rosearch) was utilized as a control against which the boots were compared. Two single boot designs were evaluated: the BFR (Singapore) and the Wellco Blast boot (U.S.). In addition, two types of over-shoes were evaluated: the Wellco Over boot and the MedEng Spider boot (Canada) in multiple combinations with the single boots as inner boots.

Level of Protection

In reviewing the strategies incorporated with current protective footwear, no boot truly utilizes one independent method. The Wellco Blast boot and Over boot utilize both deflection and attenuation through an aluminum honeycomb; however, some direct contact standoff is achieved through the increased sole thickness or the combination of two boots. Use of the Over boot also contributes additional standoff and deflects some of the energy as the boot decouples from the inner boot. The MedEng Spider boot uses open-air standoff and off-axis detonation. The BFR boot couples an Aramid upper with insole to a thicker standard sole and was the only boot tested that employed simple standoff.

Medical Outcomes

There is an ongoing misconception among some soldiers and deminers that little or no foot protection is better. The belief seems to be that, without footwear, sacrificing the foot saves the leg. If this fact were the case, there would be strong argument for this technique. Field trials show that the unprotected, or minimally protected limb, incurs a possible transfemoral amputation even with the smallest landmine.

Medical studies have shown that as the level of amputation progresses above the knee, the increased energy expenditure for walking changes from 15 percent to 40 percent with a prosthesis (Waters *et al.* 1976). Surgical amputation of the limb does not always constitute a failure of the protection or the medical care. Any protection that can reduce the number of transfemoral amputations is an improvement for the mine trauma victim.

Field trials show that the unprotected limb may mean transfemoral amputations.
Photo c/o Rountree, Harris.

Current footwear does not prevent severe injury but can provide a reduction in injury severity, especially with smaller charge weights. With the more effective boot combinations, injuries can be reduced from open contaminated wounds, which would require a possible transfemoral amputation, to a closed injury, allowing for a transtibial amputation or possible surgical reconstruction. Reduction in the potential infection rate and decrease in the number of transfemoral amputations constitutes a significant medical outcome improvement.

The study suggested that boots consisting of sturdier construction or materials, such as the Blast boot and BFR boot, seem to reduce soft tissue insult when used in conjunction with an Over boot. The potential benefit obtained from a closed injury is related to the reduction in contamination and likely infection.

Analysis of the cineradiography images demonstrated the inherent problem with a deflection strategy by showing that bony tissue damage occurs in the first few milliseconds from the initial shock wave, well before any gross movement of the limb from the blast wind. However, the amputation level for these injuries is clinically determined by soft tissue disruption. This practice would suggest that deflection of the blast wind might have a major role in preventing the soft-tissue injury. Prevention of soft tissue damage with protective equipment could shift the clinical significance and medical outcomes from the soft tissue to the bone.

The MedEng boot was the only boot tested that integrated off-axis detonation into its design. While the boot resulted in better injury outcome predictions, a limited number of samples and the inherent potential difference in injury mechanism require further investigation.

Conclusion

Review of the blast injury literature demonstrates the lack of scientific understanding of blast physics in relation to wounding. New designs and engineering developments in protective footwear technology have succeeded in reducing injury severity. The potential ability to convert direct contact blast events into non-penetrating blunt trauma is the most promising direction for protective boot strategies. Once converted to non-penetrating blunt trauma, correlation to the automotive industry databases may be possible and allow for incorporation and evaluation of new protective measures. While current, commercially available landmine protective footwear does not prevent severe injury, severity reduction associated with certain types of footwear merits further investigation and refinement before adoption in the limited mine-clearance arsenal. ■

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The Human Touch

by Russell Gasser and Terry Thomas, Development Technology Unit, University of Warwick

"Military-driven technology is useless for clearing mines in villages and rice fields."

Biting insects, inaccessible terrain, impenetrable bamboo thickets and thorn bushes. Mine clearance in Cambodia is a hot, sweaty business at the best of times. Because tripwires hidden in the undergrowth could trigger explosions, the vegetation has to be cleared by hand before mine detection can start. It is a tedious matter and can occupy two-thirds of a mine clearer's working day.

The next step, finding and digging out every piece of buried metal, is not any easier. In the dry season, the ground can be rock-hard and the deminers must move forward at a painstaking pace, probing with a prodder and digging with a small trowel. Only one in a thousand of the finds is likely to be explosive, but you cannot let your concentration slip for a moment. The majority of deminers who undertake this painstaking work are not experts but local people who have gone through a training course lasting two or three weeks.

Cambodia is not alone. Current estimates suggest there could be 25 million landmines buried worldwide. That is far fewer than was previously feared but still enough to contaminate one country in three and to kill or injure two thousand people every month, many of them children. Present methods of clearing land are slow, and mines can remain active for many years. Something should be done, but what?

At first glance, the answer seems obvious: bring in super-fast robots, hook them up to remote sensors and control them from afar with computers. In countries such as Britain and the United States, that is pretty much what most scientists and engineers working on mine clearance technology have been doing. In a typical advanced research lab, you will see mine-like targets planted in giant sandboxes below computer-controlled positioning equipment. The researchers will be hunched over computers analyzing mine "signatures," detected remotely by ground, penetrating radar and polarimetric infrared cameras. By combining information from these sensors, the labs can obtain stunning images of buried objects.

It is all very impressive. Yet despite the large sums that have been spent on such projects, the results to date have been of no use to humanitarian deminers working in heavily mined countries, such as Cambodia, Mozambique, Angola and Afghanistan. What has gone wrong is that researchers have made detecting buried mines their goal. But priorities in real mine fields are quite different. Vegetation and tripwire clearance and discriminating between mines and scrap metal are the key problems. To pursue expensive technologies designed for finding mines in level lawns is to woefully misunderstand what deminers actually do.

Part of the problem is that almost all the lab research is driven by military needs. Generals may want to clear a safe passage through a mine field quickly at night or under enemy fire. In humanitarian demining, what matters most is not speed but the ability to completely clear the land so that it can be returned to the community. This means that potentially useful methods are often developed to meet the wrong objectives.

Self-monitoring prodder. Self-contained, no wires.
Photo c/o Russell Gasser

For example, the ability to detect explosives without laboriously having to excavate scrap metal could be a boon. One promising method uses neutron bombardment to detect the nitrogen in explosives. When nitrogen captures neutrons, gamma rays of a known energy are produced and can be detected. Another technique is "nuclear quadrupole resonance (NQR)," a form of nuclear magnetic resonance (NMR) that can detect chemical bonds specific to an explosive by the way atomic nuclei absorb radio waves. Unlike NMR, NQR uses the Earth's magnetic field instead of powerful magnets.

The problem is that research into such approaches has been aimed at making them as fast as possible for military use, almost regardless of cost. Humanitarian deminers require cheap and highly dependable tools, even if they are slow. And the notion that techniques such as NQR will be vital to clearing "plastic" mines has been overstated. Most so-called "plastic" mines actually contain a metal firing pin that sensitive metal detectors can now find. Only in a few well-defined zones, usually high-tech war zones, can a tiny number of special zero-metal mines evade detectors and have to be found by other methods such as prodding.

In any case, the extended timescale of research programs, which may not produce results for a decade, represents a major problem for the mine clearers. Afghanistan plans to clear all its potentially most productive and useful contaminated land by 2007. Some 4,000 deminers have already removed 850,000 mines, and mine clearance is now Afghanistan's biggest source of employment.

A common argument for replacing these human deminers with machines and software is that it will be less risky and more efficient. In fact, it is likely to be neither. New software is notoriously unreliable, and advanced electronics is out of place in many mined areas. Deminers in rural Angola have enough problems getting batteries for their metal detectors.

Besides, a skilled deminer looks and feels for suspicious objects simultaneously. They also listen for the sound of tools touching metal or plastic and make rapid decisions based on sparse information in unique situations. No machine, with or without batteries, can duplicate these skills. The fact is that human deminers are clearing land more safely than ever before. Accident rates are around one per 30 persons per year, and this statistic is declining.

While generously funded lab research has failed, simple pragmatic ideas developed in the field have yielded major improvements in humanitarian demining in recent years. For example, both commercial and NGOs have fitted mine-clearance tractors with agricultural flails to clear vegetation. Either the driver is protected by thick sheet steel or off-the-shelf remote controls enable driving from a safe distance. Similarly, home-made armored excavators are being used to sift through mined building rubble. Using the simple protective equipment now being manufactured in countries such as Cambodia, Pakistan and Zimbabwe, a deminer can sometimes walk away from an anti-personnel mine explosion with only scratches.

To pursue expensive technologies designed for finding mines in level lawns is to woefully misunderstand what deminers actually do.

All of these approaches are based on an intimate understanding of local needs and human resources that have so far evaded hi-tech research. We have seen a similar pattern emerge many times in the developing world in the past 20 years from agriculture and water supply to urban transport and rural telecommunications. Everyone wants mine clearance to be safer, faster and cheaper. Scientists could help by making their work more relevant, but deminers despair that this will never happen. Someone, somewhere must try to prove them wrong. ■

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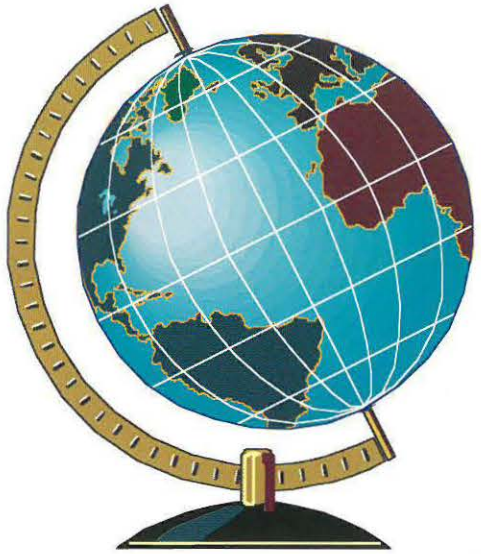


International Standards *for Personal Protective Equipment*

by Colonel Alastair McAslan, GICHD, *and Keith Feigenbaum,* MAIC

Introduction

International Standards for Mine Action are being revised by the United Nations. As part of the revision process, a working group on personal protective equipment (WGPPE) has been established to examine the subject of safety in mine clearance operations, and to make recommendations on standards and guidelines for PPE. This paper is based on the WGPPE's report.

The concepts of safety, risk and risk management are not new to humanitarian mine clearance. Risk management involves the identification, analysis, assessment and removal (or at least reduction) of risk. The term implies dominance and control of the risk, and the application of agreed processes to achieve consistent results.

It is necessary to clarify the meaning of the term safe in respect to mine clearance. To say that a situation is safe implies a final judgement that the risk is in some sense acceptable or tolerable, or even nonexistent. However, the terms "acceptable" and "tolerable" imply human judgement of the situation and judgement may be tentative, transient and fallible.

A Systems Approach to the Problem

A recent international study of mine accidents and incidents carried out by Andy Smith on behalf of the U.S. Department of Defense (DoD) has revealed that in the vast majority of cases, victims either failed to wear PPE correctly or were engaged in activities which contravened local Standing Operating Procedures (SOPs). A simple statement of the blast and ballistic protection levels alone would be inadequate for international safety standards. A systems approach considering the threat, training, operating procedures, supervision, equipment capabilities, environmental factors and protection levels is needed to enable managers of mine clearance operations to decide appropriate local requirements for PPE.

Mine and UXO Threat

Though the term "threat" is not often found in general safety literature, it is frequently used in mine clearance to describe the extent of risk at a particular time in a particular country, province or district. Threat is a useful concept and we must establish a common understanding of its meaning and application.

Whereas "risk" refers to the probability and severity of a single occurrence of harm, the threat from mines and UXO refers to the sum of local risks in an area or theatre. In mine clearance, the probability of harm is a combination of the quantity of munitions with the potential to cause harm and the probability of failing to detect a single active mine/UXO. There seem to be three components of any threat within a given area: (1) The type of hazard (fragmentation, blast or incendiary), and the severity of physical harm which would result from its unintended detonation; (2) The detectability of mines and/or UXO; and (3) The quantity of mines and/or UXO within a given area.

Threat is dependent on time as well as area. In some mine-affected theaters it will *reduce* over time from demining and through effective mine awareness training. In other theaters it may *increase* over time from uncontrolled vegetation coverage, soil movements and the cumulative effects of weather.

The threat can be demonstrated graphically as shown in Table 1 below. This example, which uses data from Bosnia-Herzegovina, attempts to illustrate the antipersonnel (AP) mine threat in Sector MND(SW). In general, mines towards the top right of the table represent a greater threat than those towards the bottom left. The size of the circle is proportional to the quantity of mines.

Risk Management

In recent years, the concepts of risk, risk management and safety have received much attention from industry and academia. This attention can be explained in part by a moral imperative and by a growing sense of duty, but it is mainly driven by the impact of litigation. The International Organisation for Standardisation (ISO) has had to address these issues in the workplace. ISO guidelines for the development of safety standards are relevant, and the ISO approach has proved to be an appropriate model to guide the work of the WGPPE.

Notwithstanding the legal imperatives to reduce risk, humanitarian mine clearance imposes a moral duty of care that demands attention be given to the consequence of all actions, and also to the consequence of inaction. The latter is often overlooked, and is particularly relevant to those in positions of authority, supervision or of professional standing in humanitarian mine clearance.

Health and Safety

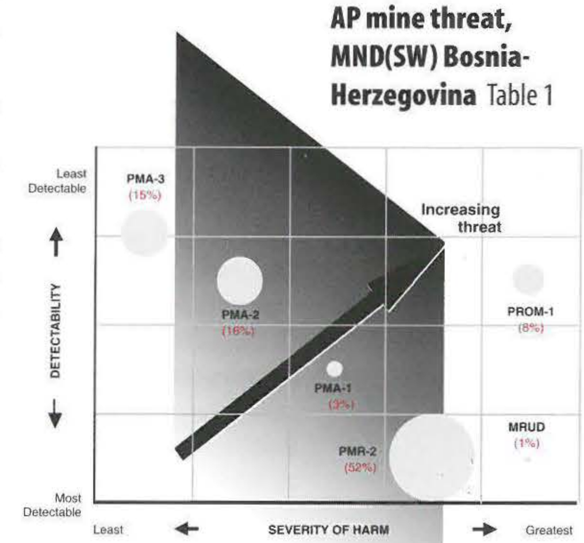
The International Labour Organisation (ILO) is a specialist agency of the United Nations, which seeks the promotion of human and labor rights. The ILO formulates international standards in the form of Conventions and Recommendations by setting minimum norms, including basic standards regulating conditions of work and the workplace. In 1981, the ILO adopted a Convention (C155) and related Recommendation (R164) on Occupational Safety and Health.

Precedent and norms already exist at international level to provide guidance for the development of new international standards for safety in mine clearance. The concept of responsibility included in ISO and ILO documents implies the need for accountability. In particular, the responsibilities and obligations of the national authorities, mine action centers, the employers and employees, as required by the ILO, should be applied to the management of mine clearance and be included in the revised safety standards.

Mine Incidents and Accidents

Risk reduction involves a combination of safe operating procedures, education, training, effective supervision and PPE. In adopting a systems approach, the WGPPE considered it necessary to analyze and evaluate the relationships between these factors before deciding whether the residual risk to deminers is "tolerable." This conforms to the approach taken by ISO in developing safety standards.

AP mine threat, MND(SW) Bosnia-Herzegovina Table 1



Much of the WGPPE's analysis and many of its conclusions on PPE have been derived from the Database of Demining Incident Victims (DDIV) compiled by Smith. The database covers mine clearance incidents in Angola, Afghanistan, Cambodia, Bosnia-Herzegovina, Mozambique and Zimbabwe.

The DDIV is a record of explosive incidents involving deminers. The victims were employed by NGOs, commercial demining companies, national agencies and, in some cases, the military. The current release (Version 1) of the database contains the records of 319 victims and 249 incidents.

Mine and UXO Hazards

AP blast mines are the most abundant mines encountered in humanitarian mine clearance and cause the greatest number of injuries. At close quarters, AP fragmentation mines overmatch the PPE currently available. Due to the area effect of such mines, they also have the potential to effect secondary victims. AT mines normally require significant pressure to detonate and are less hazardous to manual deminers unless employed in a non-conventional manner. Effective PPE against AT mines is not available.

In general, when UXO munitions are encountered in mine clearance operations, they have already malfunctioned, though some are specifically designed as area denial weapons. They are usually high in metal content, on or near the surface. Since most are easily detectable, they constitute less of a hazard than mines. When the threat from "advanced UXO" exists, specialist EOD teams should be used. The varied nature of UXO means that the hazard is best dealt with procedurally, rather than relying on PPE designed primarily for humanitarian mine clearance.

The effect of blast is roughly proportional to the explosive content, though it can vary according to the mine's construction. The PMN (240g) is an appropriate level to protect against, as it is one of the most common mines found in reported incidents. Most mines with larger charges (PROM-1, V69) are fragmentation mines, and the lethality of their fragmentation effects is more significant than blast.

Fragment sizes and velocities vary greatly, even from mines of the same type with grooved/notched casing. DDIV analysis shows a high percentage of fatalities from fragmentation mines (52 percent of bounding fragmentation mine incidents and 22 percent of fragmentation mine incidents); survivors were usually secondary victims. Current PPE levels do not protect against close proximity fragmentation mines but may protect secondary victims.

There is also a fragmentation hazard from the casing and inner components of some AP blast mines. Furthermore, AP blast mines buried in scree, gravel roads and tracks and in soil containing a high percentage of stones represent a particular challenge for PPE.

Harmful Activities

The most common mine clearance activities which led to harm were excavation (36 percent) and missed-mine incidents (26 percent). Excavation includes digging with any tool or investigating a previously located mine; a missed-mine incident occurs when a victim initiates a device which the deminer or any other member of the demining unit has failed to locate. While excavating, almost all deminers were injured in the squatting or kneeling position.

Areas of the Body at Risk Table 2

	Severe	Minor	Total
Head and neck:	94	148	242
Upper Limb:	92	142	234
Lower Limb:	109	98	207
Trunk:	40	77	117

Less than 10 percent of incidents involved deminers (mis)handling or holding the mine during examination or disarming. Nearly seven percent of incidents involved behavior considered dangerous or careless, such as stepping outside a cleared and well-marked area.

Only two percent of all incidents involved an accident *during* detection. It should be noted, however, that this low figure may disguise the practice of "detection by excavation," which is sometimes applied.

Areas of the Body at Risk

The DDIV classifies non-fatal injuries as severe if they were likely to be life threatening, to require surgery or to result in permanent disability. All other injuries are classified as minor. The distinction is not intended to reflect the suffering and/or hardship associated with any injury. The areas of the body at risk are summarized in Table 2 below.

The risk of severe injuries to the head and to the limbs (both upper and lower) is similar, but the risk to the trunk is not as severe. The majority of head and upper limb injuries were caused while excavating and from (mis)handling incidents, whereas the majority of lower limb injuries were caused by missed-mine incidents.

(Note: The lower number of injuries to the trunk cannot be explained by the provision of PPE since the DDIV suggests that in the majority of cases the victims were not wearing any body protection).

Environment

The diversity of environmental factors make it difficult to generalize about their impact on safety as a whole and on PPE in particular. Climatic extremes are a constant concern in some theaters through high temperature, humidity or cold. In addition, there may be local environmental problems which demand use of specialized PPE or life support equipment.

Analysis and Discussion

Perception(s): It is often assumed that minimum metal mines represent the greatest risk to deminers, as they are, at least in theory, the most difficult to detect. However, this assumption is not confirmed by the number of reported injuries. The majority of missed mine incidents involve a PMN, PMN 2 or PPM-2 and all have significant metal content. There may be a psychological "risk adjustment," which causes deminers to operate with greater caution in areas where minimal metal mines are expected.

Fatalities: Incidents resulting in death show a disproportionate number resulting from bounding fragmentation mines. AP blast mines account for the next greatest number followed by larger mines. Vegetation clearance produced the highest number of deminer fatalities. Handling or manipulating mines (some during the process of disarming) proved to be the second highest readily identifiable activity at the time of death.

Injuries: Evidence suggests that AP blast mines were the most common cause of deminer injury (62 percent), of which the PMN and PMN-2 series caused 38 percent of the incidents.

Protection: A fragmentation jacket or apron of some kind was issued to under a third of the victims recorded in the DDIV. It was worn in only half of those cases, and visors were temporarily discarded or raised by 56 percent of the victims issued with them. The thickest visors commonly worn were 5mm thick. These appeared to provide adequate protection against blast and were considered wearable by deminers. There was also evidence of severe hand injuries resulting (at least in part) from the use of inappropriate hand-tools during manual demining.

Risk Reduction

Risk Management: Risk reduction involves a combination of factors, including safe operating procedures, education, training, PPE and effective supervision. Though international guidelines and national SOPs can provide advice on how this can be achieved, the responsibility for risk management lies principally with the employers be they national teams, demining NGOs or commercial contractors. This responsibility must be embedded in the management culture and practices of all organizations involved in the planning and prosecution of humanitarian mine clearance operations.

Control and supervision: There is much room for improvement in the control and supervision of humanitarian mine clearance operations. Over 50 percent of the injuries recorded in the DDIV were apparently caused by inadequate "field control." Improved field discipline and control through education, training and supervision would reduce the risk to deminers. It would also increase the overall efficiency of clearance operations. An accident causes substantial dislocation and delay in addition to the obvious injuries to the victim and to the socio-economic impact on his family and community.

Reports and Investigations: There is significant variation in the quality and timeliness of reports and post-incident investigations. Consideration should be given to the development of an international standard for reporting and for the conduct of investigations and inquiries. Though local requirements may vary, there is a need to maintain objectivity and impartiality and to facilitate lessons learned about risk and safety issues.

PPE Requirements

Human Factors: The frequency with which deminers fail to wear PPE suggests that equipment and clothing is either inappropriate or is already at or beyond the "wearable" limits of weight and mobility, though some improvements could be achieved through better field discipline. Any assessment of PPE requirements must recognize the limits of acceptability by addressing the human factors, including environmental conditions and ergonomics.

Associated Equipment: The systems approach to risk reduction includes an understanding of the interface between the deminer and his/her associated equipment. In this respect, the selection and use of hand-protection and appropriate hand-tools is particularly important and should be considered as an integral part of the PPE requirement.

Blast: The explosive content of a PMN is "... just under the threshold for overpressure injuries." Larger explosive content is generally confined to fragmentation mines where the lethality of fragmentation is more significant than blast. The DDIV provides no evidence to suggest the need to protect against overpressure from AP blast mines, yet tests conducted by Canadian Defence Research Establishment Suffield (DRES) suggest the possibility in certain cases of "... severe, critical or unsurvivable injury."

Fragmentation: Current accepted levels of PPE provide inadequate protection against fragmentation mines at close quarters, and procedures/processes must be applied (with conviction) to reduce the risk to a tolerable level. PPE should continue to be designed to protect "secondary victims" against fragmentation mines.

Boots: Blast-resistant boots which are designed with at least a 10cm stand-off may reduce injuries when stepping on small blast mines, but they impair mobility and are unlikely to be accepted for general use though they may have some specialist application. There is no clear evidence to suggest that blast-resistant mine boots, without any stand-off, would reduce injury to an acceptable level. Indeed, some evidence suggests that such boots may actually worsen the severity of leg and groin injuries when stepping on a PMN. Further evidence from study and independent

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Comparative Study

of Different Lightweight Head Protection Systems with Full-Face Visors for Humanitarian Deminers

by J. Nerenberg, S. Islam, Dr. A. Makris and J.P. Dionne, Med-Eng Systems Inc.

Introduction

A key component of any Personal Protective Ensemble (PPE) for demining is the helmet and/or face shield. For obvious reasons, protecting the face of a deminer is of utmost importance in case of an accidental detonation of a mine. Currently, a wide range of head and face protective devices are available for the deminer, and this study attempts to evaluate these devices from several perspectives.

Like any other explosive, when an AP landmine detonates, a blast wave is generated along with an impulsive burst of fragments and an intense fire flash spreading in all directions. The impact and ensuing interaction of the blast wave from such a detonation with a victim (a deminer) can lead to a wide range of effects. Under extreme conditions, intense blast loading can lead to shearing of body parts. These injuries occur in the form of traumatic amputations, such as those observed in victims who have stepped on landmines. With respect to the effects that are important for the deminer's head, the extreme levels of blast strength are usually not considered, as the head is usually at least 0.5m away from the mine.

Test set-up of mannequin Figure 1

Photo c/o Med-Eng Systems Inc.

Yet, at these distances, several different effects can occur due to the detonation of a blast type AP mine. The overpressure of the blast wave emanating from the mine can cause injury to the deminer's ears. While ear damage can lead to loss of hearing, this injury is not life threatening, but it is one with potentially detrimental social consequences. When the blast wave interacts with the head of the deminer, violent levels of acceleration can be induced in the victim's head. Due to this acceleration, a range of minor to deadly concussive injuries can occur.

Fragmentation is a potentially lethal threat, even when coming from a blast-type AP mine. Fragments, traveling at extreme velocities, can be composed of gravel, pebbles, sand, mine casing pieces or parts of the mine mechanism. Injuries to the head from fragments include cuts in soft tissues as well as injuries to the brain, brain stem, face and eyes. The eyes are particularly vulnerable to fragmentation injury with blindness being the obvious consequence.

Heat from a blast also can potentially cause injury. If the victim is sufficiently close to the mine, such that parts of the person's body—including the face—become engulfed in the fireball of the explosion, burns can occur.

In order to examine these effects and to evaluate the ability different technology in head protection has in preventing or reducing these effects, simulated blast-type AP mines were detonated in front of instrumented anthropomorphic mannequins realistically placed in the deminer's prodding position.

Experimental Details

Positioning of Mannequins and Instrumentation

Full-scale tests involving instrumented anthropomorphic Hybrid II mannequins (representing the 50th percentile North American male [height: 1.75 m, weight: 77 kg]) were carried out where the mannequins were placed in deminers' positions. In order to place the mannequins in the correct position, an advanced blast resistant positioning apparatus was utilized (Figure 1). For the purposes of this study, two mannequins were used, one on either side of the simulated mine. One mannequin, in a kneeling on one knee position with its sternum 0.66m to 0.68m from the simulated mine (corresponding to 0.80m distance between the mine and the mannequin's nose) represented the typical distance a deminer's sternum would be from a mine while using a prodder of about 40cm (±10cm). In order to examine the effect of distance, the other mannequin was positioned such that its head was 0.70m from the mine. Figure 1 illustrates this test setup, with mannequin one (on the left) being 0.80m from the mine (at the nose) while mannequin two is at 0.70m distance.

Simulated mines, consisting of C4 plastic explosive packed snugly into injection molded puck-shaped plastic containers, were buried with one cm

The Sport Helmet Figure 2a

Photo c/o Med-Eng Systems Inc.

of overburden in front of the mannequins. Three sizes of simulated mines, containing 50, 100 and 200g of C4, were chosen to represent a wide range of blast type AP landmines.

In order to quantify the performance of the helmets and visors, each mannequin was instrumented with a cluster of tri-axial accelerometers (PCB) in the head along with a pressure transducer (PCB) for measuring overpressure at the ear. All instrumentation lines were connected via appropriate power supplies and signal conditioning equipment to a computerized data acquisition system. For further detail concerning this experimental procedure, please refer to [Appendix A, 1]. This method of testing is currently under consideration for use by the Canadian Center for Mine Action Technology (CCMAT).

Helmets and Visors Tested

There are several different types of lightweight head and face protection systems available to the deminer, designed and manufactured by several organizations. In this study, three types of lightweight protective helmets were evaluated. The first was the Sport-1 Helmet developed by Med-Eng Systems, which is composed of a lightweight sporting helmet (used for such activities as climbing or kayaking) with a full-face visor mounted onto it (Figure 2a). The sporting type helmet was chosen by Med-Eng because it is lightweight and fits the head snugly, providing enhanced stability and comfort over other common types of helmets. The Sport-1 Helmet visor is mounted by means of aluminum blocks, which are bolted to the helmet and the visor. Standard locking pins allow the visor to be held securely over the face or above the forehead. The visor extends from beneath the chin to the top of the forehead, thereby covering the entire face. The helmet uses a customized three-point retention system, which secures the helmet snugly to the head through the use of a chin-cup.

The Sport-1 Helmets, as constructed by Med-Eng, are normally made with visors of a standard thickness of 5.7mm. In order to observe the effect of thickness on the blast integrity, fragment resistance and other performance measures for this study, the Sport-1 Helmets were made with visors of two other

Construction Hard Hat Figure 2b

Photo c/o Med-Eng Systems Inc.

nominal thickness values, 4.5mm and 5mm.

The second type of helmet tested was a construction hardhat mounted with a full-face visor (Figure 2b). This system, designed and constructed by another organization, has a 4.3mm thick ballistic visor mounted by means of plastic mounting blocks on both sides of a construction hardhat. The visor covers the area from beneath the chin to the top of the forehead. Retention to the user's head is achieved by the use of an under-the-chin strap. The visor is mounted on the back of the helmet such that the brim of the helmet does not interfere with the visor (the helmet is worn backwards so that the visor covers the face). The visor cannot be locked in the open or closed positions, rather it is held by friction. This Hardhat head protection system has not been developed by MES, differing significantly in design from the Hardhat helmets (Hardhat-1 and Hardhat-2) evaluated in [Appendix A, 1].

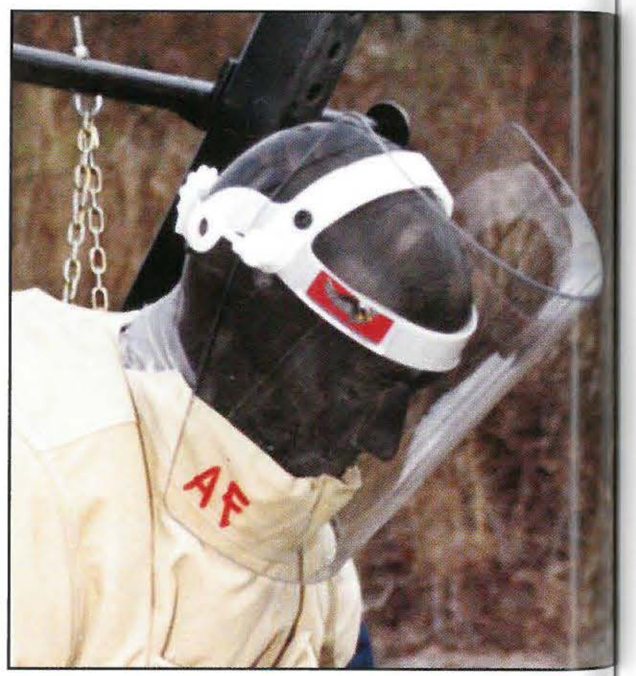
The third type of system tested, also built by another institution, is a full-face visor mounted on an adjustable Headband (Figure 2c). No chinstrap is provided on this Headband system, but it is expected to remain snug on the head by adjusting its circumference. The visor is of sufficient size to provide continuous protection from the neck up to and including the forehead. Similar to the Hardhat system, this visor cannot be locked open or closed, but it is held by friction. The nominal thickness of the visor is 4.8mm.

Use of a Chest Plate

The HDE Demining Ensemble, developed by Med-Eng Systems to provide protection to the deminer's body, uses a chest plate designed to integrate with the visor of a demining helmet. The bottom of the visor tucks in behind the chest plate, thus providing continuous protection from the chest to the top of the head (Figure 2a). The role of the overlapping chest plate and visor is to prevent the mine blast from reaching inside the visor and to aid in keeping the visor over the deminer's face during such a blast. During most tests with the Med-Eng Sport-1 helmets, the full HDE Demining Ensemble with its chest plate, recommended by Med-Eng Systems, covered the body of the mannequins. In some tests, in order to evaluate its effect, the chest plate of the HDE was removed.

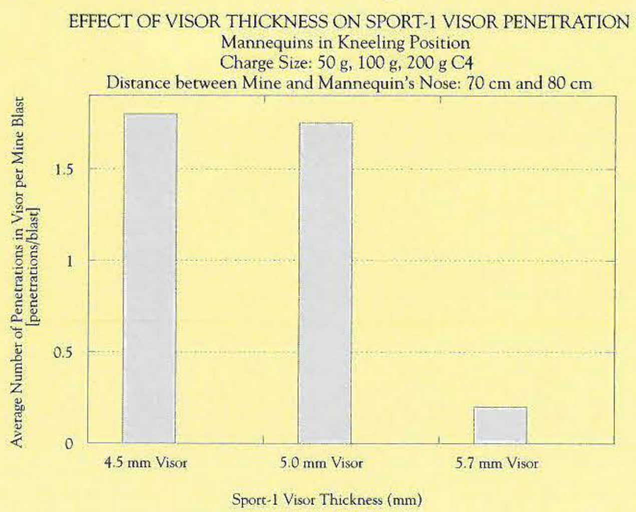
Full-face visor mounted on adjustable headband Figure 2c

Photo c/o Med-Eng Systems Inc.



The Hardhat and the Headband systems, on the other hand, are not designed to be used with an integrated chest plate and are most often used with some sort of soft ballistic apron or vest. Due to this use, there is a clear and open path for the blast to reach inside of the visor and the user's face. Furthermore, due to the shape of these visors, they would not be able to integrate properly with the HDE chest plate. With these factors at hand, in the tests described herein, these two systems were used in conjunction with the HDE Demining Ensemble, but the chest plate was removed in order to simulate a standard flakvest or ballistic apron.

Average number of complete penetrations through visors mounted on Sport-1 Helmet' effects of visor thickness Figure 3a



Results and Discussion

Visor Penetration

One of the main objectives of a visor is to protect the face from fragments emanating from the detonation of the mine. Whether a visor will be penetrated is dependent on several factors, such as visor thickness, mass of the explosive charge, distance between the mine and the visor, depth of burial and the size and density of fragments in the soil.

From this study, it has been ascertained that even a slight increase in visor thickness can have a dramatic effect on the levels of fragmentation protection to the face and head. Figure 3a illustrates the effect of the different visor thickness mounted on the Sport-1 helmets; the thinner gauge visors performed poorly when compared to the thickest visors. On average—over all charge sizes and distances from the charge—the 4.4mm and 5mm visors were penetrated 1.8 and 1.75 times per blast, respectively, while the 5.7mm visor was penetrated only 0.20 times per blast. These results indicate that for the thinner visors between one and two fragment penetrations were likely to occur in each test, but for the thicker visors, a penetration would occur on average only every fifth test. These results are averaged over all three sizes of simulated mines used at both standoff distances.

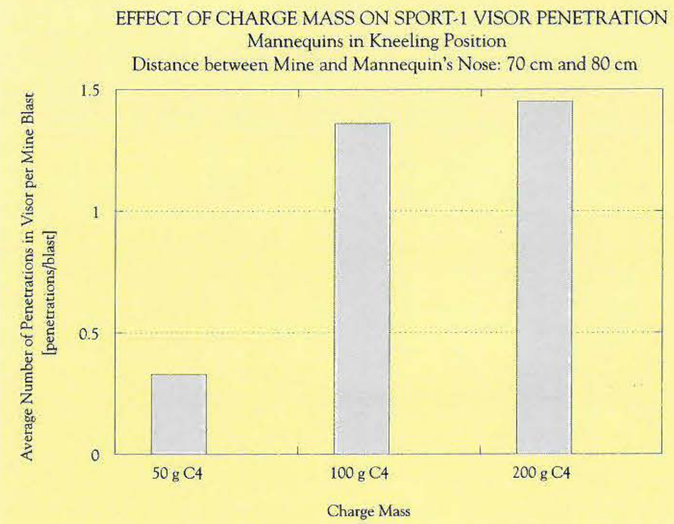
The effect of charge mass on visor penetration is illustrated in Figure 3b, which shows that the number of penetration through the Sport-1 Helmet visors (all thicknesses) per blast increases with charge mass from 0.3 per test for 50g C4 to 1.4 for 200g C4.

When a mine detonates, the fragment density (the number of fragments in a given area) decreases dramatically with distance from the mine. Therefore, as a deminer increases his distance from a mine, or any other detonation, one can expect to interact with, on average, fewer fragmentation particles emanate. Furthermore, as the distance increases, the energy of the fragmentation particles decreases. Due to these factors, one would expect fewer fragmentation penetrations as the distance increases from the mine. This supposition is confirmed in Figure 3c where the number of penetrations per test at a distance of 0.8m, on average, was approximately half of that when the visors were 0.7m from the mine.

Visor Shattering and Cracking

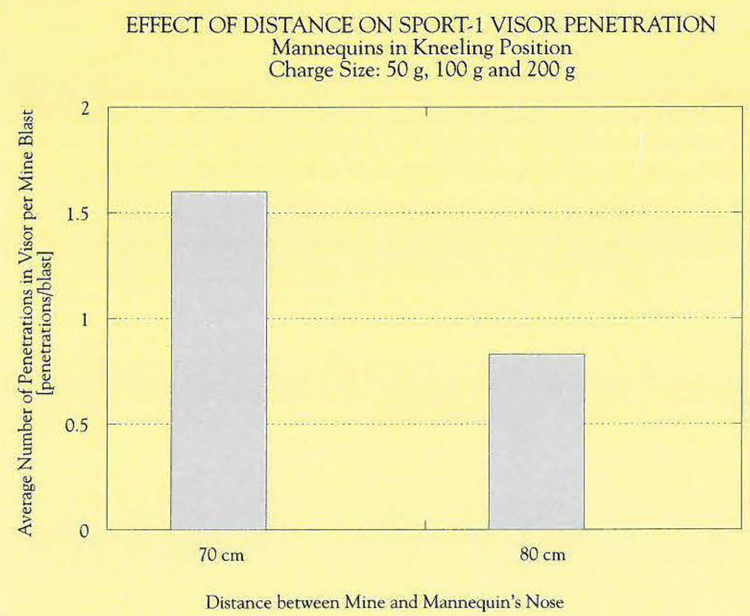
The penetration resistance of the Hardhat and Headband systems has not been directly compared to the performance of the Sport-1 helmets because a different phenomenon occurred with these systems.

Average number of complete penetrations through visors mounted on Sport-1 Helmets' effects of charge mass Figure 3b



Instead of a fragment punching a hole in the visor, in many tests, these visors broke into two or more pieces. In comparison, the 4.4mm visor of the Sport-1 helmet was cracked on two occasions, but this crack was far less catastrophic in nature. Rather than the visor breaking into pieces, a 5-7cm long cut was made, but the overall integrity of the visor remained. This result illustrated that the visors of the Headband and Hardhat systems are far more brittle and prone to

Average number of complete penetrations through visors mounted on Sport-1 Helmets' effects of distance Figure 3c



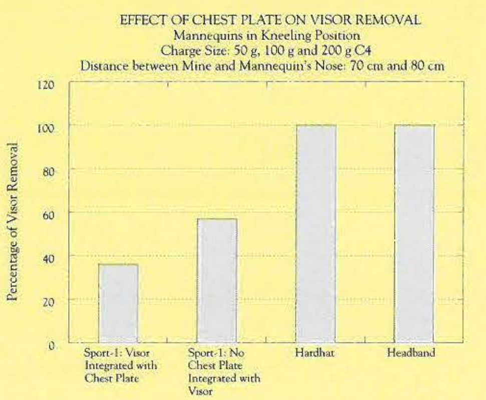
Visor from Hard Hat ejected from face and found in front of mannequin after blast Figure 5a

Photo c/o Med-Eng Systems Inc.

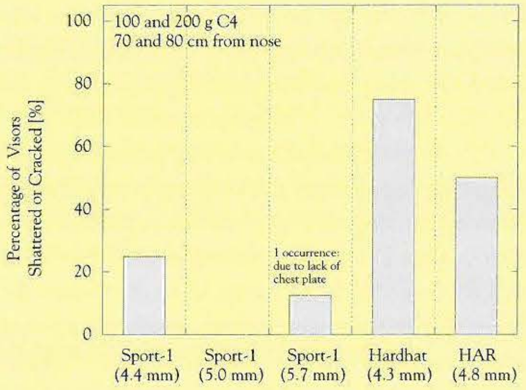
Visor from Headband system ejected from face Figure 5b

Photo c/o Med-Eng Systems Inc.

Percentage of visors removed from face during blast, illustrating effect of overlapping chest plate and properly mounted visor Figure 6



Percentage of visors shattering or cracking for the various head protection systems tested when facing 100g and 200g simulated mines Figure 4



failure than the visors manufactured by Med-Eng Systems. Figure 4 shows the percentage of helmet visors which cracked or shattered for all five helmet types when facing the 100 and 200g C4 mines (the 50g C4 mine results are not included, as this threat level never caused any visors to shatter). It can be seen that the Hardhat visor, which was the thinnest of all those tested, cracked and shattered most readily followed by the Headband system.

Effect of Chest Plate on Visor Removal

In order to provide effective and continuous protection to the face of a deminer during an accidental detonation, the combination of a full-face visor mounted on a stable helmet platform and integrated with an overlapping chest plate is imperative. A visor that is not securely mounted has a high probability of being removed during the blast event, creating the possibility of secondary fragmentation, overpressure and heat reaching the exposed face. Figures 5a and 5b illustrate examples in which the visors of the Headband and Hardhat systems were ejected from the mannequin's face during the blast event. Figure 6 illustrates that when a visor is not properly held in place on a stable helmet platform combined with an overlapping chest plate, it is much more likely to be removed from the face during the blast. The Hardhat and Headband systems had their visors removed from the face in 100 percent of the 18 tests, independent of charge size and distance from the mine. However, when the Sport-1 helmet was used with an integrated chest plate, the visor was removed in just over 25 percent of the 19 tests (usually when a larger charge size was used or when the visor was at the closer distance to the charge). The benefit of a stable helmet platform alone was illustrated when the interfacing chest plate was removed from the HDE, as the visor was removed in 60 percent of the 14 experiments. That is, more often than when the Sport-1 helmet was used with a chest plate but much less than when an unstable mounting platform was used without an integrated chest plate. It should be noted that the Sport-1 helmet, as part of this study, was in its prototypical stage. Due to the occasional failure when the visor was removed during the mine blast, the Sport-1 helmet is being extensively revamped and improved in order to prevent similar occurrences in future tests.

Consideration of Heat Effects

Figure 7 provides evidence that protection from the thermal effects of a detonating mine is required. In both pictures, the detonation of the mine created a fireball that easily reached the heads and torsos of the mannequins. In order to protect the deminer from receiving burns as a result of this fireball, protective clothing is required. The ability of a visor to remain in place during the blast event will prevent burns.

Effects of Helmets and Visors on Ear Overpressure

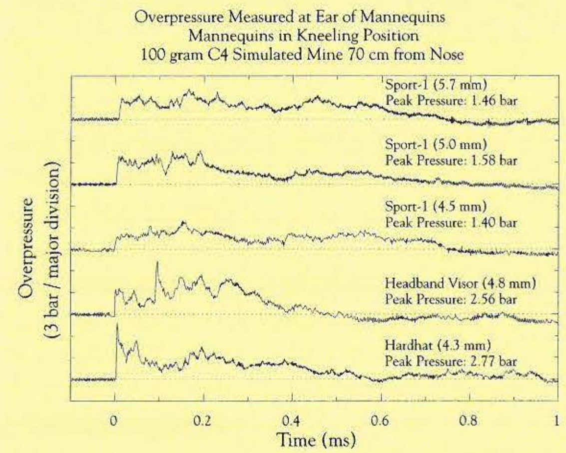
As part of this study, pressure measurements were made at the ear of the mannequin in order to evaluate the effectiveness of the different head protection systems in reducing the overpressure levels that reach the ear of a deminer in the case of an accidental detonation. Figure 8a shows typical traces of overpressure measurements obtained at the mannequins' ears when they faced a blast from the 100g C4 simulated mine at a distance of 0.70m. Figure 8b illustrates traces when facing the 200g C4 simulated mine at a distance of 0.80m. From both figures, it can be observed that the peak overpressure for the Sport-1 helmets is essentially independent of visor thickness but that the peak pressure increases significantly for both the Headband and Hardhat systems. This result is not surprising, as one would expect the peak pressure reaching the ear to be a function of geometry. The Sport-1 helmets have the advantage because their visors are tucked in behind a chest plate to limit the blast overpressure's ability to reach the ear. The Hardhat and Headband systems do not operate in this fashion, so the blast wave can easily get behind the visor and readily reach the ear, which most likely contributes to the higher overpressure (this factor also causes the visor and headgear to be easily removed from the head during the blast event).

Figure 9 shows average peak overpressures mea-

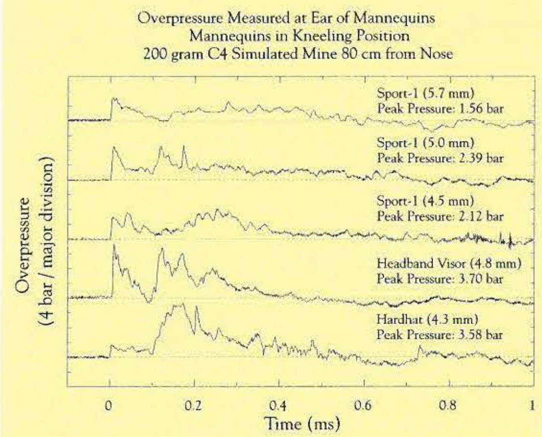
Fireball from detonation of simulated mine enveloping the heads of the mannequins Figure 7

Photo c/o Med-EngSystems Inc.

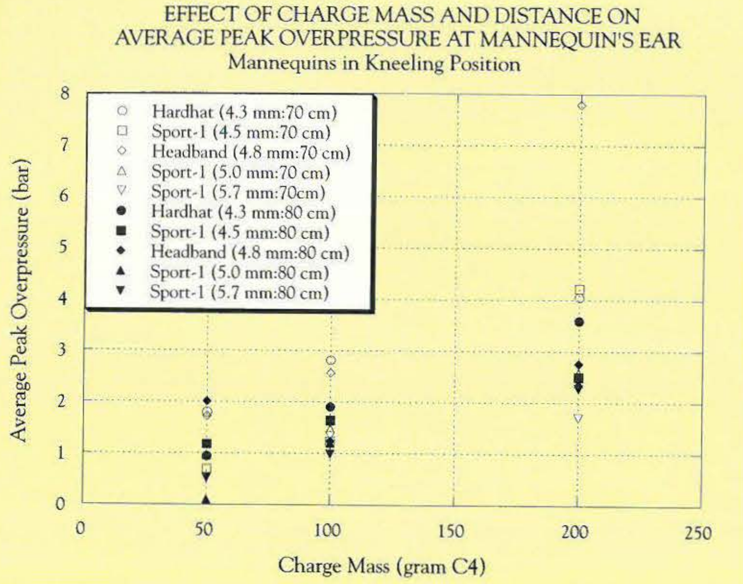
Typical overpressure signals recorded at the mannequin's ear for different head and face protection systems, charge masses and distances between the mine and the mannequin's nose. 100g C4 at a distance of 70cm Figure 8a



Typical overpressure signals recorded at the mannequin's ear for different head and face protection systems, charge masses and distances between the mine and the mannequin's nose. 200g C4 at a distance of 80cm. In both cases, the mines had an overburden of one cm. Figure 8b

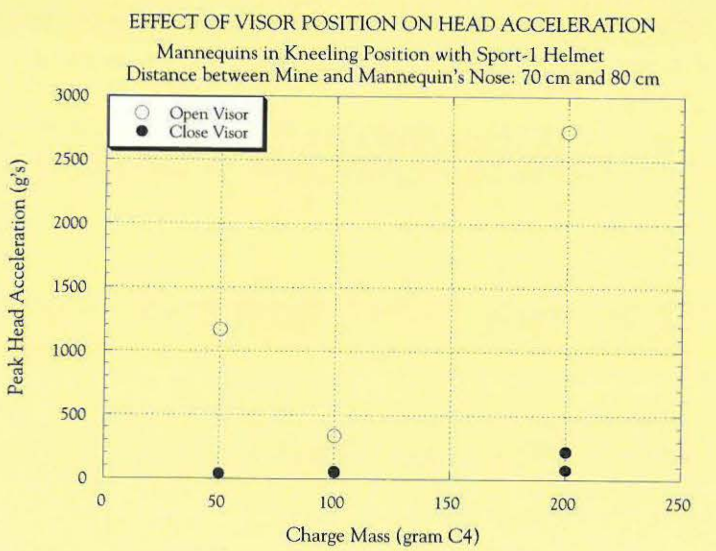


Average peak overpressure measured at the mannequin's ear for different head and face protection systems with mines at distances of 70cm and 80cm from the mannequin's nose Figure 9



sured at the ear of the mannequins for different charge masses and both distances tested. It is shown that the peak overpressure at the ear increases with increasing charge mass and decreases with distance for a particular type of head protection system. In general, the measured peak ear overpressures for all Sport-1 helmets are less than those for Hardhat and Headband systems, which can be attributed to the reasons stated above. For further discussion on the ear overpressure in a demining context, please see [Appendix A, 1].

Effect of visor position (open or closed) on head acceleration Figure 10



Effects of Visor Position on Head Acceleration

A visor is an essential part of the overall head and face protection system and should be kept in a closed position during demining. In many demining theaters, deminers tend to keep their visors open to gain comfort in a hot climate or due to limited visibility because of scratching and fog. This practice may have severe consequences in the event of a detonation. There is the obvious effect of leaving the face exposed to the blast wave and fragmentation, thereby dramatically increasing the chance for severe injury to the face, such as blindness. However, the other effects not often thought of are the accelerative or concussive effects on the head. With the visor open, a large concave surface area is created for the helmet and visor to catch and trap the blast wave. This effect can cause the head to be accelerated backwards at a rate much higher than when the visor is in the closed position (the blast can pass over the relatively streamlined, convex surface of the visor in its closed position). Figure 10 shows the effect of open and closed visors on the head acceleration for the Sport-1 helmet and for different charge masses. The effect of a visor position is obvious, as the peak acceleration can be an order of higher magnitude with an open visor compared with a visor in the closed position.

Conclusion

An initial evaluation of a range of lightweight demining helmets has been performed from several perspectives. It has been shown through tests designed to accurately represent an actual demining accident scenario that, with respect to lightweight helmets, several factors must be considered in order to provide the deminer with adequate protection.

By performing tests with visors that range in thickness, it has been demonstrated that even a small increase in visor thickness can tremendously affect the ability of a visor to prevent high velocity fragmentation from reaching the face of a deminer. In the tests performed for this study, it was demonstrated that by increasing visor thickness from five to 5.7mm, one could decrease the chance of a fragment penetration by over eight times. Furthermore, the effect of decreasing one's distance from a mine was shown to a have a marked effect on whether a fragment would penetrate a protective visor—thus indicating the importance of increasing stand-off distance whenever possible.

Visor manufacturing processes were also illustrated to be of paramount importance. The visors not manufactured by MES were more likely to catastrophically crack or shatter into several pieces, whereas the visors on the Sport-1 helmets did not show this tendency. In fact, it was demonstrated that visor thickness is not indicative of potential for failure compared to how well the visor was manufactured.

In order to ensure that the deminer is protected from a detonating mine, it is required that a protective system remain over the head and face throughout the blast event. It has been demonstrated that in order to ensure this scenario, both a stable helmet platform and an integrated chest plate are essential. The Hardhat and Headband systems, which have neither feature, had their visors removed from the faces of the mannequins in every test—even against the smallest of the charge sizes. On the other hand, the form-fitting Sport-1 helmet (unlike the Hardhat, which, like any other construction hardhat, sits high on the head) and visor that can be integrated with a chest plate were removed in far fewer tests and, usually, only when facing a large charge size.

One rarely considered benefit of having a visor remain in place over the face throughout a mine detonation was demonstrated by observing the intense short-lived fireball, which can easily engulf the deminer's upper body, including the face. The presence of a visor will ensure that burn injuries are kept to a minimum. The overpressure at the ear was also shown to be positively affected by a proper head protection system, as the Sport-1 helmets consistently permitted lower peak overpressure levels to reach the ear, as compared to the Hardhat and Headband systems.

All of this evidence provides a clear picture of the equipment required by deminers to effectively perform their duties. If one chooses a lightweight head/face protective system, it should have several key characteristics. It should have a visor that is manufactured properly in order to prevent catastrophic failure, and one of sufficient gauge to minimize the possibility for fragmentation penetration. It should be mounted onto a stable platform—most likely a snug fitting and strong helmet with a comfortable and effective retention system. How the helmet interacts with the other protective equipment should also be taken into account. The bottom of the visor should integrate with an overlapping chest plate, as this structure greatly enhances the ability of the helmet to function properly. Finally, the helmet's use and care is of great importance. If the visor is treated properly in order to prevent scratches and maintain clarity, it is more likely to be used in the down, or closed, position. A visor used in the open position not only opens the face to the threat of fragmentation and heat but it also increases the possibility of concussive injury in the event of a detonation. ■

Appendix A

[1] Makris A. Nerenberg J, "Full Scale Evaluation of Lightweight Personal Protective Ensembles for Demining in Providing Protection Against Blast-Type Anti-Personnel Mines," In *Journal of Mine Action*, James Madison University, Harrisonburg, Va., Version 4.2–Online, June 2000.

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notes FROM the FIELD

we didn't think it would happen to us

▪ by Chris North, Handicap International

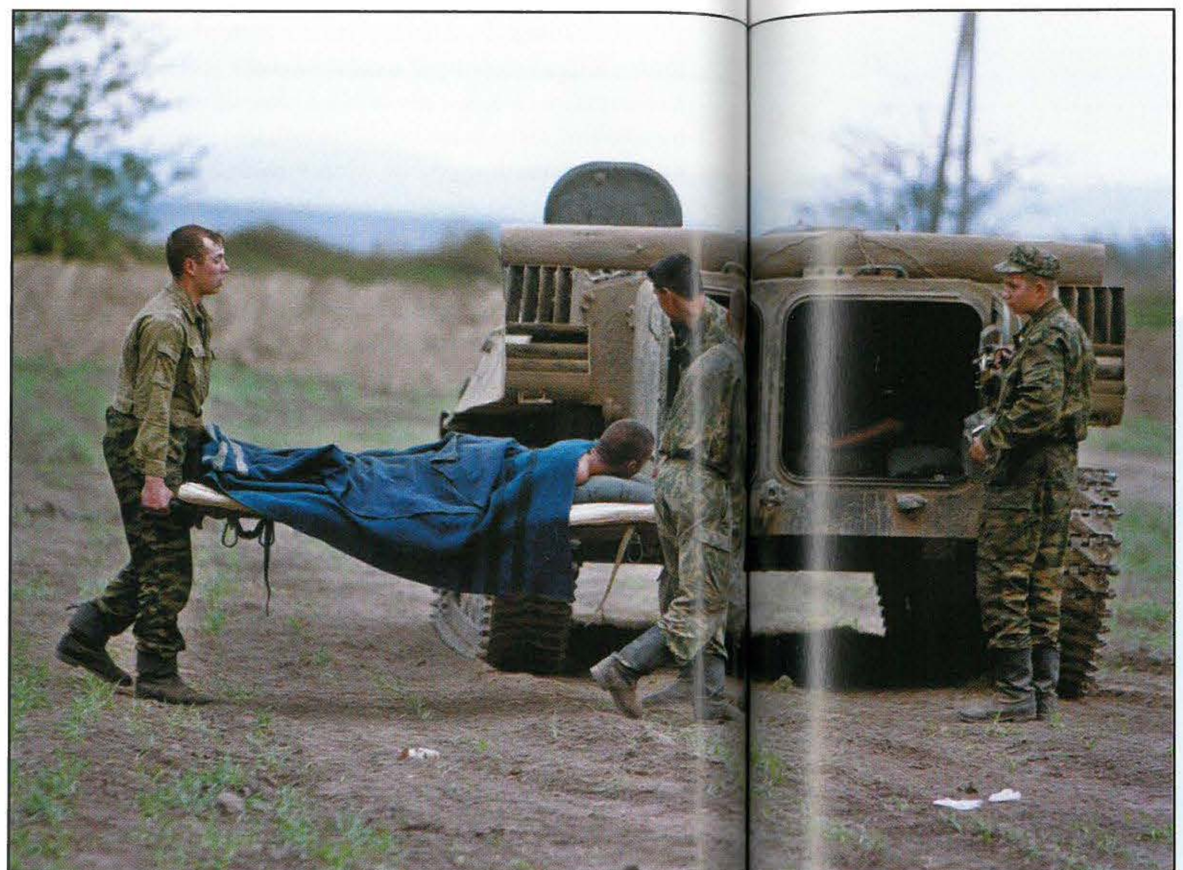

Photo c/o AP/ World Wide Photos

"Medic, Medic, Medic!" the radio bursts into life, the voice louder than usual, almost excited but in control.
A definite sense of urgency delivered with those few words.
Everyone is quiet, nobody breathes, only the radio is alive.
Just listening and moving into action:
"Mine strike, a man is down,
Team four, lane two,
Injuries to hands and arms,
Still conscious, bleeding too much. Over."

Not really thinking, now just reacting: *"Hotel Zero Charlie, roger—we're mobile for your location. Wait. Out."*
By the time the message ends, the emergency team is on the way; there are four deminers to rescue the man from the mine field, two trauma medics and an ambulance with driver, all moving swiftly and smoothly.
This well-oiled, well-rehearsed rescue machine glides into action, no need to talk or discuss.
Everyone on auto-pilot, slipping easily into practiced drills, all praying that it's just another training scenario.
But everyone knows by the butterflies in their chest that this is the real thing.

We knew it was real because we heard the explosion.
It wasn't the loud crack we're used to hearing when we blow up a stockpile of mines.
No, this was an almost gentle "pop."
The violence of a small explosion softened by distance.
On site, the leader heard the bang.
He had sent the radio message almost before the noise had finished, before it registered in his conscious mind that an accident had happened.
No time for emotion or panic. He has a job to do, stay on top, in control.
Don't let anyone just rush into the mine field to help—we don't want another accident.

Team leader stops all the other deminers from working.
Get a head count; is everyone accounted for?
Make a quick rescue plan, does this without thinking.
Almost seems easier than the practices he's used to.

About this time, I've made a call to headquarters, told them the facts, which hospital we intend to go to,
The casualty's identification number and blood group.
Then the rescue team and medical team arrive; it seems like ages since *that first radio call.*
It's been exactly two minutes, forty-seven seconds.

The medics start to call to the casualty—he doesn't respond.
Is he unconscious or dead?
Three minutes since the explosion happened.
The rescue team of four deminers start working in pairs, carefully and calmly they begin to clear a route.
Once they reach their friend, I go in.
It's now been eleven minutes, twenty-two seconds.
As they put him on the stretcher, I begin telling the medics what to expect:
"Right hand missing, damage to left and right upper arm, both thighs are bleeding, unconscious,
breathing O.K., wrist stump pumping blood."
I apply pressure to the stump, can't stop the blood from spurting, hands slip, can't get a good enough grip.

Now we're back in the Safe Lane.
Before I realize, the medics have put a drip in him starting to replace some of the vital fluid he's lost.
Then a tourniquet, then a bandage, bleeding almost stopped.
All the time, the medics are talking to him.
Three calm, professional, caring voices.

I realize that I am out of breath.
I can't remember when I started breathing again.
It's been thirteen minutes and thirty-seven seconds.
Loaded in the ambulance, he starts to come around.
Trying to talk, so we listen.
He says, "I'm sorry I let you down."
Pain is starting to take hold.
One small morphine injection.
We're on the way to the hospital now, speeding down rough, narrow tracks, sirens screaming, seem strangely far away.
Pull through the gates, tires screech as we stop.
They are ready for us.
Headquarters has done its job.

And then he's gone, taken from us.
As he disappears, his last words to us are
"I'm sorry."

Forty-five minutes exactly.
I look around at the medics and the driver.
They all look really exhausted.
I'm tired. ■

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notes FROM the FIELD

poetry from the mine field

▪ by Chris North

"What We Do"

With protection on and helmet tight,
Equipment tested and ready,
We cross the line to start the search.
Our movements slow and safe and steady.

Through waist high brush and piles of rubbish
And house after house in a line,
We clear the ground and mark our route
To hunt the hidden mine.
Each day we walk the ground we've cleared
To prove the job's done right.
We check each morning to ensure
No mines were laid last night.

With weather so cold
The prodder burns the fingers of your hand.
Other times so hot sweat stings your eyes;
It takes so much effort to stand

Whatever the weather, be it hot or cold,
No matter what comfort we need to endure,
We search the ground with prodder in hand.
We must be safe, we must be sure.

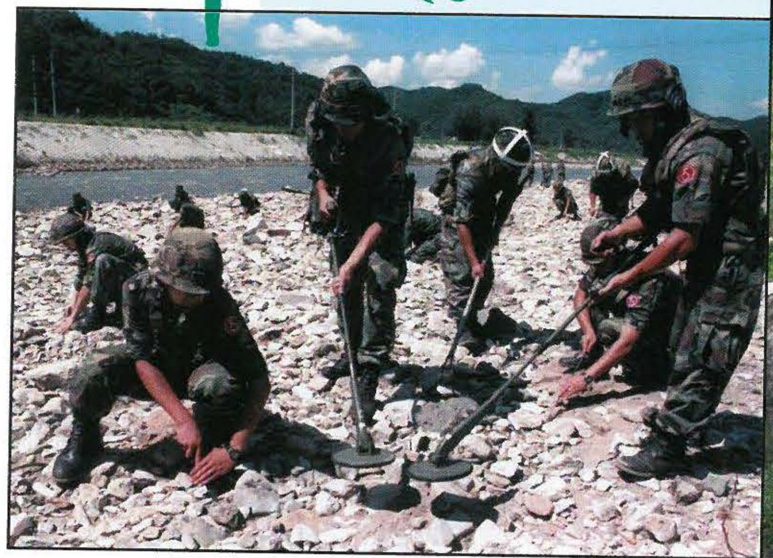

Photo c/o AP/World Wide Photos

Photo c/o Oren Schlein/ Adopt-A-Mine Field Program

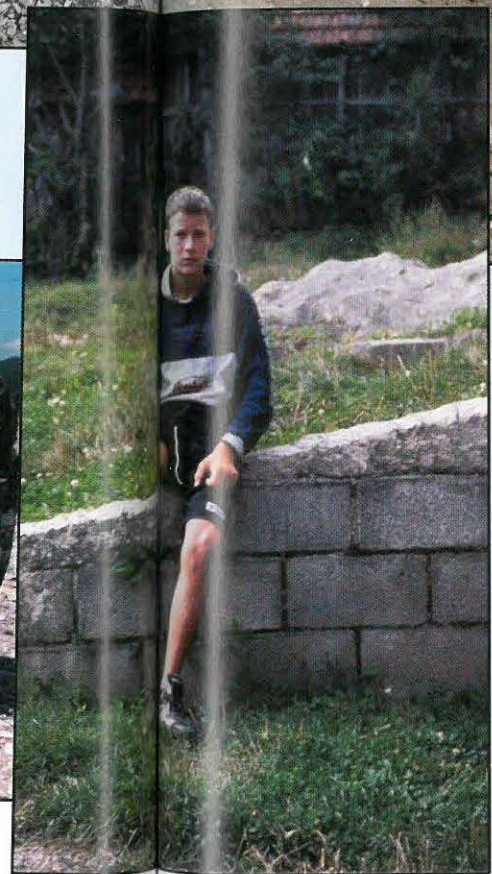

Photo c/o ICRC/Lan Woodmansey

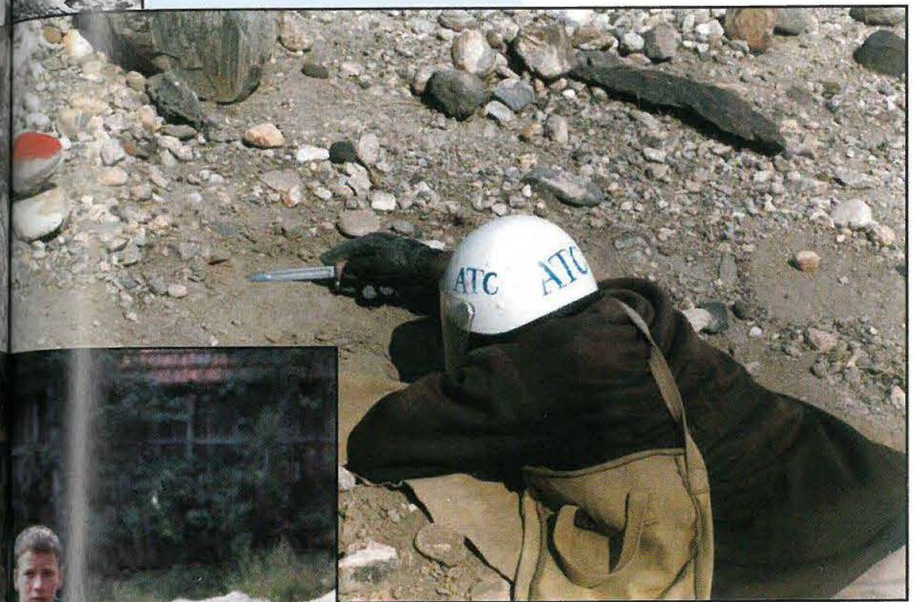

Photo c/o ATC

"The Silent Assassin"

This quiet sentry waits, he doesn't care how long.
He waits alone or in groups for you to come along.

The assassin is ready, he remains ever alert.
He can wait for years to do his job, he cares not who's killed or hurt.

The very old or the innocent young, he sees them all the same.
He lies in wait to trap them all, he must achieve his deadly aim.

We look for him, we hunt him down wherever he may lie.
We play with him his deadly game, one of us must surely die.

Like night of old with armor for battle we prepare.
Slowly moving forward, hunting, we probe the ground with care.

Then something hard is felt beneath; if it is a stone, then all is fine;
But if not, we now prepare for mortal combat with the mine.

With visor down and armor on and with prodder at the ready,
We gently probe beneath the mine, stay cool, stay calm, keep steady.

So far so good, no booby traps so there is one less worry.
Slowly now with steady hand uncover the mine, don't hurry.

There he is, still waiting, even after years in the ground.
His body of plastic, as good as new, still working, still sound.

Carefully, with steady hand, now comes the vital part:
Gently lift, reach underneath and unscrew this demon's heart.
It's over now, this battle won, another victory filed;
One less assassin in the ground.
One less to hurt a child.

This is one battle won, but the war still goes on.

"What Is He Thinking?"

When a deminer steps forward to do his work,
Who knows what's inside his head.
Who knows what he thinks whilst doing this job,
Where just one mistake could leave him for dead.

Does he think of his wife and his children,
Does he think of their future?
If he makes a mistake and sets off a mine,
Who will take care of them after he's dead?

Demining he doesn't think of such things,
Focus on the job instead,
Mind just concerned with finding the mine.
If his thoughts wander, he could end up
Dead.

notes FROM the FIELD

poetry

"Risky Business"

No matter how much we follow the rules,
No matter how hard we try,
Each time the prodder goes in the ground
We know we could die.

Each time we search the ground ahead
Using tripwire feelers with care,
A blinding flash could be the first we know
That a tripwire mine was there.

That even when we checked the ground ahead
With detectors tuned so fine,
We know when we move forward that
Our feet could find the mine.

We put all these drills together,
Confirm and check and test,
Working hard, constantly improving
To make our drills the best.

So we trust in all the drills we use.
To improve, we continually try.
But demining is a risky business,
And deminers often die.

"Who Knows"

It's when I'm alone that it starts to bite,
When I've nothing to do and it's late at night,
These thoughts creep in,
Evoking worry like sorrow,
Will I survive the day or be killed tomorrow?

Will the next landmine I touch
Be the last thing I see?
Will I be killed or maimed,
What will happen to me?

I'm sure it won't happen, but
I know that it might.
These thoughts come to haunt me
Sometimes in the night.

When night drifts away and
Morning seeps through,
My confidence returns in the things that I do.
Worries recede as the morning turns bright,
I am eager again to get on with the fight.

Those haunting memories
Seem like decades away,
But they return at the end of each day.
Confidence deserts me,
The day draws to a close.
Will I survive or die tomorrow?
Who knows?

Poems reprinted with permission from Handicap international.

Chris North is a retired senior non-commissioned officer and EOD operator working for Handicap International. He leads a team of 30 men who risk their lives every day, locating and disarming landmines in Bosnia. His wife, Janice, and their two young children live in Scotland. His poetry collections have been published in two books, "Risky Business" and "War Trade."

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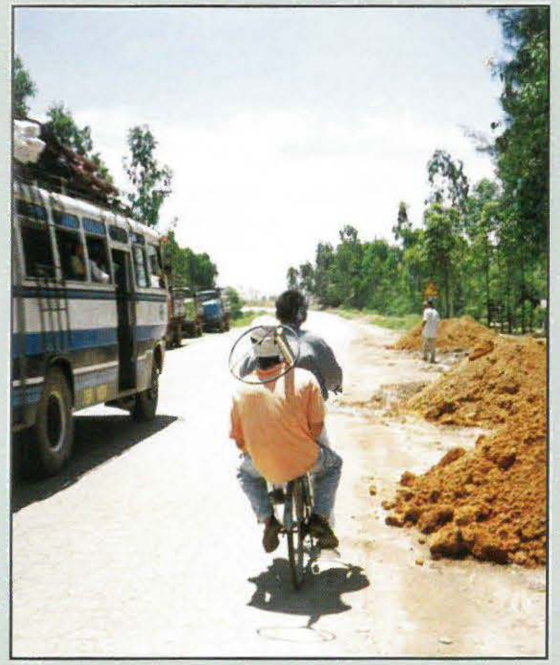
Hobby Deminers in Quang Tri Province

▪ by Douglas Patt
Senior Program Manager, Mine Action Program, Quang Tri Province, 1998-1999

UXOs in scrap yards.
Photo c/o Mark Pirie



"Hobby deminers" heading to work.
Photo c/o Mark Pirie

In the old days, anybody driving Highway 1 through the Vietnam central coastal regions could see neat stacks of unexploded ordnance (UXO) displayed everywhere beside the road. All the dangerous debris of past wars lay there like alien goods in storefront windows, each cairn marking the location of a scrap metal dealer. About four years ago, the Vietnamese government determined such displays inappropriate for a country moving to re-establish itself as a presence in the world community. The UXOs disappeared from view. The scrap metal dealers either removed their inventories to caches in the countryside or moved them behind screens.

In Quang Tri Province, hunting for, recovering and reselling scrap metal from UXOs remained one of the few income-generating activities in one of the most economically depressed places on the planet. Passers-by can still see UXO stacks, but now they have to stop, park and walk inside the fences of the scrap metal dealerships.

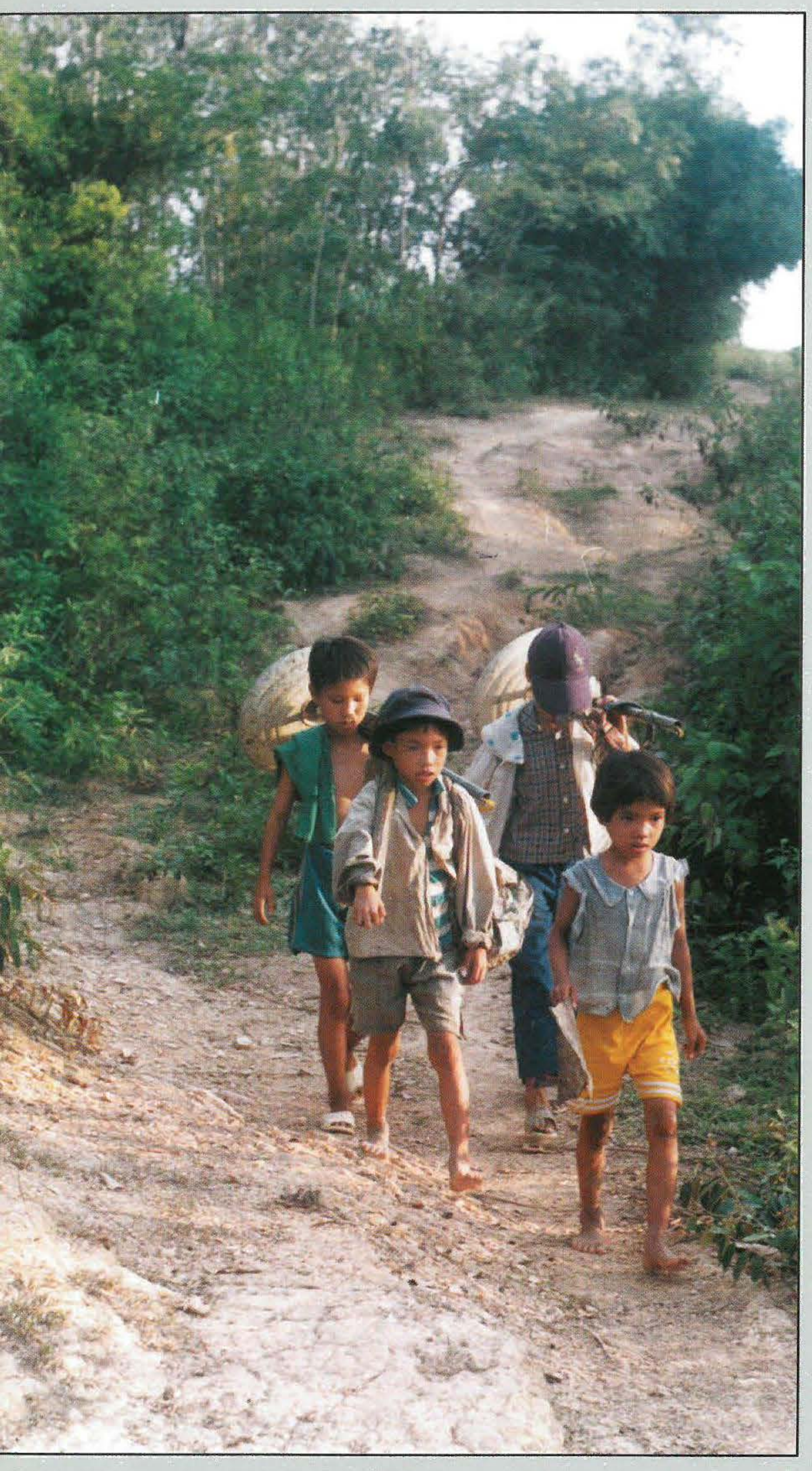
Quang Tri Province (QTP) is located almost at the midway point between the northern and southern tips of Vietnam—where the "DMZ" used to be during the American War. Quang Tri, in other words, was the front line—a combat zone where more bombs were dropped (measured in raw tonnage) than fell on all of Germany throughout the Second World War.

As a result, QTP is littered with UXO-artillery rounds of all calibers, air-dropped bombs ranging from 2,000 pound giants down to tennis-ball-sized "bombies," mortar rounds and grenades. Of all this "pollution," perhaps the most dangerous to the life and limbs of the people of Quang Tri are M-49 grenades and the M-32 cluster bomb units the Vietnamese call "bombies." The M-49 and M-32 are small enough that children take them for toys... sometimes with sad results.

Boy with blast injuries to his legs. Quang Tri Province.
Photo c/o Don Price

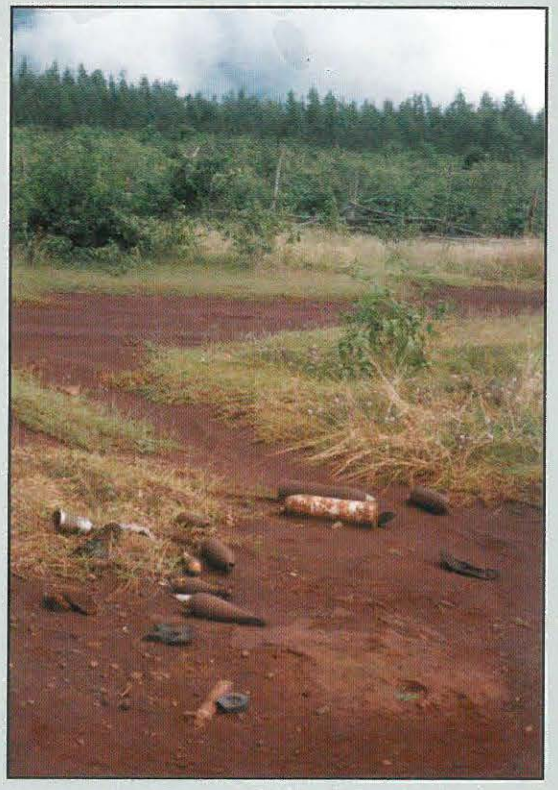
notes FROM the FIELD

Hobby Deminers in Quang Tri Province



Four children carrying homemade mine detectors. Dong Ha, 1999.
Photo c/o MAP

Post monsoon. UXOs exposed in a wash.
Photo c/o Mark Pirie



As they enter the puberty years, those same boys who might have played with the UXOs they could find lying exposed everywhere in Quang Tri might also become "Hobby Deminers." Equipped with homemade metal detectors, these boys now actively seek out UXO, which they can sell for a few cents to the dealers.

If those boys survive their learning experiences, they might well become adult "Hobby Deminers," the nickname given by professional deminers (Vietnamese military and NGO contractors) to the civilians who make a living seeking out, defusing, transporting and selling UXOs for profit.

The equipment the "Hobby Deminers" use is ingeniously constructed. They analyze the component parts of commercially produced metal detectors and reproduce the technology using what they could find: the rings cut from metal transistor radios tuned to pick up the faint radio emissions most metals give off, hi-fi stereo headphones and scrap wire.

Most of the time, the "Hobby Deminers" unearth relatively small UXO, antique barbed wire, etc. Sometimes, they get…lucky? The man in the picture below, sitting on the ground beside his find, certainly was lucky, twice. He found an unexploded 500lb. bomb with the entire explosive material still inside (bonus payment) and defused it for transport without making any final mistake in the process.

At the scrap metal dealer, the UXOs are processed for sale. Precious metals must be separated. Often, a young man will use a hammer to knock the aluminum rings out of the impact detonators taken from 105mm artillery rounds. The detonators are still technically "live." Aluminum and copper are the most valuable of the scrap metals commonly found littering Quang Tri. The steel in the jackets of expended artillery rounds and bombs, for the most part, is recycled and used by automobile manufacturers.

The Vietnamese government attempts to discourage civilians from handling or seeking out UXOs. The people of Quang Tri are fighting against the pressures of poverty even though there are national-level initiatives and programs in place to enhance the transportation infrastructure of the province and to attract business and international aid investment to Quang Tri. For the near term, however, there are few incentives to discourage children and adults from trying to make some money from the dangerous scrap metal trade. ■

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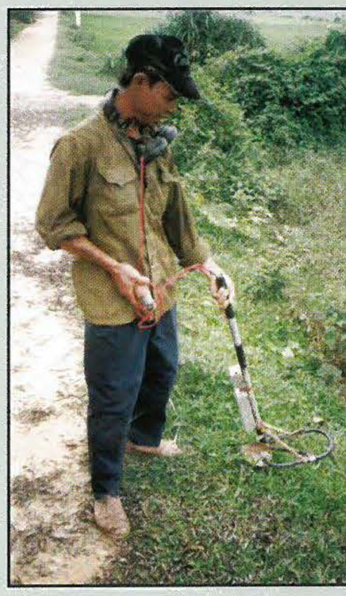
Roger Hess, UXB International, and Mr. Duc, MAP driver/interpreter, inspect a 500lb. bomb that just rolled off the back of the truck in front of the scrapyard. Note: bomb has been defused but still contains high explosives. Quang Tri Town, Quang Tri, May 1999.
Photo c/o Douglas Patt

Amateur deminer, Dong Ha, Quang Tri Province, 1998.
Photo c/o Don Price



Amateur deminer's kit packed for travel. Dong Ha, Quang Tri Province, 1998.
Photo c/o Don Price

RONCO Executives Talk About Demining Integration and the IMAS Contract

An Interview with Lawrence Crandall, Stephen Edelmann and A. David Lundberg

by Margaret Busé,
MAIC

Can you give me a brief history of how RONCO got started with demining?

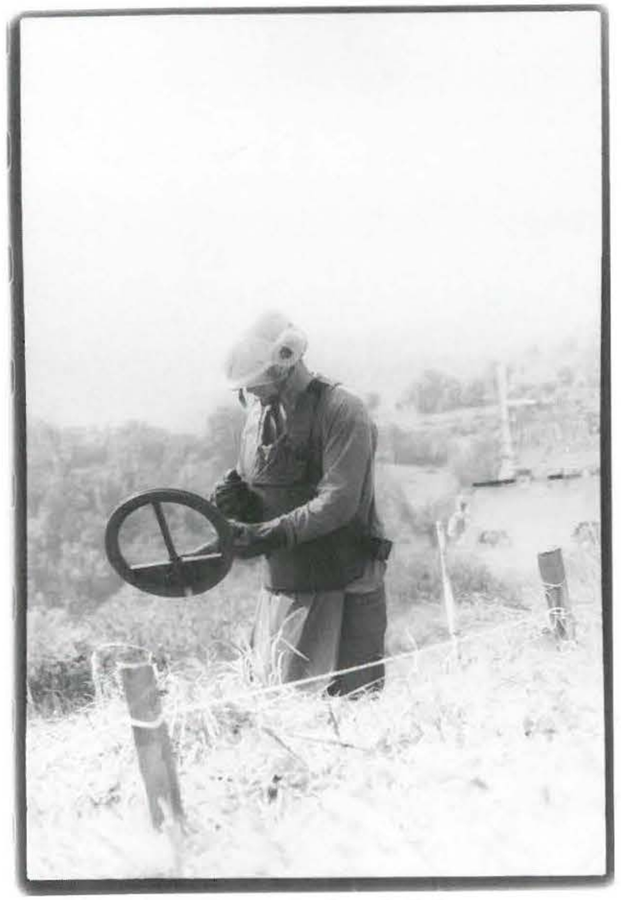
Stephen Edelmann: We started working internationally in 1980. In the late '80s, we won an open competition to assist the U.S. government in running a humanitarian assistance program in war-affected Afghanistan during the Soviet occupation. Part of that program was training Afghans on the use of mules as pack animals so that they could bring supplies over the mountain. When that program was done, we suggested to the U.S. Embassy that they try a pilot program using mine-detecting dogs and to approach the Thai Army, who had a program, to contribute to the Afghanistan war effort. That was done, and the Thais contributed 14 dogs and trainers. We used the facilities that had been previously used for the mule training. The program was very successful, and the U.S. government asked us to expand it and establish a mine dog training center and to train a cadre of Afghan NGOs that, to this day, still continues to successfully operate in the form of an NGO we created. We left them with 92 mine-detecting dogs along with a full coterie of vehicles and supplies. This program has continued to expand and now employs over 4,000. This is a prime example of RONCO's philosophy—to help develop institutional capacity and indigenous personnel. From here, we moved to Mozambique where we won a contract to clear 2,200 km of road that allowed over one million Mozambican refugees to return to their homes. We have been involved in demining for over 12 years, probably longer than anyone in the field.

The Afghanistan Mule Training Center became the first mine dog center. RONCO originally imported pack mules from Missouri and Tennessee to help war-torn Afghanistan get supplies over the mountains.
Photo c/o RONCO

Can you tell me some of the challenges in setting up a successful demining program?

Edelmann: They range from logistics to cultural. Wherever we go, we are going into a difficult environment because it is post conflict and that requires innovation on our part. We have no external support and have to rely on ourselves to set up facilities, procurement, security and administration.

Lawrence Crandall: Historically, the challenges have changed over time. Initially, for the Afghan program, the challenge was to get the U.S. government to agree to fund the first humanitarian demining program because there were no policy precedents, guidelines or experienced personnel in the bureaucracy. The only demining the U.S. military had done was for tactical and military purposes. Humanitarian activities were not to be found. The challenge was trying to resolve a very serious issue. There was a multi-billion dollar humanitarian program to assist the Afghans, but a lot of the people we were training were being killed or maimed by mines. We were seeing our investments in these people lost. Washington had no sympathy. There was no lobby; there were no handbooks that showed you how to do it, and a conservative bureaucracy was afraid of it. We finally involved a sympathetic senator from New Hampshire and a Texas congressman, and they successfully lobbied for the program. That was done, and the program started. Once we got the demining program going in Afghanistan, we tried to hand it off to the U.N., and they would not go anywhere near it. They said, "Oh no, we don't do this." Again, it was because of a lack of precedent and experienced personnel in this area. We wanted to phase out and institutionalize it, so we approached various international NGOs, and no NGO would touch it. So, we ended up running the program many years longer than we would have liked and finally handed it over to the U.N. Today, we are facing different challenges. Dave is starting a demining program in Albania.



RONCO deminer ready to start his day in the field.
Photo c/o Tony Allen/RONCO.

A. David Lundberg: The Albania program is remotely located on the Kosovo-Albanian border. There is no infrastructure that you can plug into. We are essentially picking up a piece of our Bosnia operation and moving it to Albania. Finding housing, medical supplies, food, transport—everything you need for this type of operation—is part of our concern. We must import Bosnian deminers into Albania because there are no trained in-country personnel available. Anytime you are working in the developing world, it is difficult. The biggest challenge we face is building and developing indigenous capacity. It was easy to do in Kuwait, which was a huge operation, and it was easy to bring in expats and machinery, do the job and leave. Building indigenous capacity to leave behind, that is what gets difficult. You have to affect both training and attitudinal changes. For instance, it is typical to hear that Muslims won't work with dogs. That is simply not true when you get them exposed to the use of dogs. When we went to Mozambique, we were told by a number of people that there would be no way we would get them to use dogs because the Portuguese use dogs as police dogs and attack dogs. You just have to overcome these stereotypes. RONCO has been able to overcome this because we started as a development firm. We have a history working in the developing world, so we know how to work in that environment, and we brought our expertise to demining. It is, initially, the same. You are just dealing with a different end product. You are developing deminers, dogs, logistics, people and medics.

How do you monitor the success or difficulties of your established programs once you have left a country?

Edelmann: With the Afghan program, we sent people back periodically for a number of years to monitor the dogs and the training. In Rwanda, we were tasked with incorporating a mine dog program into the military, which is winding down. We will probably use the same tactic there. We will send people back to monitor the quality, training, etc. Our approach is to wean ourselves from the program as quickly as possible consistent with the ability for our counterparts to take over. The Afghan program is doing great six years after we have left. That is the key: Can you go back three, four, five years later and see what is operating successfully? We left the Afghans with the capacity not only to function efficiently and effectively in the field, but also from a financial standpoint. This ability allowed them to approach donors with confidence. One of the reasons is that donors can see where their money is going from the financial system that we helped them set up. In a donor's mind, that is a significant point. We try to establish a competency technically but also efficient administration. Which country you are working in and what their requirements are also determines what you need to do. You may be at one end of the spectrum, like the Afghan program where you are setting up everything, or the opposite end, like in Namibia where you are only doing basic demining.

Crandall: In Afghanistan, we created an NGO; in Rwanda, a government capacity was created. In the Balkans, RONCO helped develop three commercial companies, and they are operating and bidding on projects on their own and, in some cases, becoming part of our competition and sometimes our partners as well.

Edelmann: Our clients, for instance, like the U.S. Department of State, determine these tasking. Collaboratively, we come up with a program that works. In the Balkans, we had to set up three private companies because the government, at the time, offered us little choice. The Bosnian-Croat side had no working government, the Serbs were considered outlaws and the Muslims, like many others, were in disarray—this is what the situation was like in 1996. An NGO didn't seem feasible because of impenetrable regulations. So, we decided to develop private companies. The situation determines what we do.

Does RONCO just set up indigenous capacity, or do you actively get tasked to remove mines?

Lundberg: It's a little bit of both. In Rwanda and Afghanistan, we were tasked with specific jobs. On the Kosovo/Albanian border, we were tasked with removing mines from the border and not to worry about building indigenous capacity. In the case of Mozambique, we cleared 2,200 km of roads. We ended up going in and training Mozambicans from scratch for dog handlers, logistics [and] transportation, and when we left, we left with that capacity sitting there. We draw on that capacity to assist RONCO with other demining operations like using the Mozambicans on the Kosovo-Albanian border. We do this at far lower cost than using U.S. technicians.

Edelmann: Here is another example of how much indigenous capacity building contains costs. Because there was uncertainty as to clearance rates and procedures, we were contracted by the DoD to perform quality assurance in Guantanamo Bay behind a Marine Corps demining operation. We brought in our Bosnian deminers. Not only does this keep your indigenous capacity working, but also, it is exceedingly cost effective. People have said for many years that it takes a lot of money to take mines out of the ground—not so. In Mozambique, we were able to clear 2,200 km of road at 31 cents a square meter; the standard is $1.50 (U.S.) a square meter. It is not the cost of taking the mine out of the ground; it is the clearing of the area that is suspect. If there is an explosion in a field and you don't know if there is a mine field there or if it is an isolated explosion, you have to survey that entire field and clear it.

Lundberg: In the case of Mozambique, we were there for two years, and the initial mobilization costs were high because you are starting up a whole operation. The longer you are in a place doing this, the cheaper it gets. One of our biggest problems is that many of our efforts are short efforts—two to three months. The costs for mobilizing to do 200,000 sq. m are similar to the costs of being there for two years. So, if you were to look at our costs for being on the job for two months, the costs are pretty high. If you were to extend those costs two years, those cost per square meter at the end of the day are going to be a lot less. If Mozambique had been a two month program, the cost would have been three to four dollars per sq. meter.

Are your surveys mostly done for you or do you have to go in and do the surveys?

Edelmann: It's a mixed bag. We get tasked, as in the Balkans, with areas that survey work that needs to be done. In Rwanda, the surveys had already been done.

Lundberg: We are very careful about going in behind a survey that has been done. It can quickly become apparent that a survey may not have relevance. So, we always check with what is there.

Crandall: We are starting a new project in Thailand, and the surveys are being done now by other donors. At the request of the Thais, our task leader is involved in the scope of the work. Our man out there is monitoring the surveys on a regular basis, and he knows the individual who is heading the survey and trusts him.

Edelmann: You are putting people in jeopardy. You have to have confidence in the survey.

Many of the NGOs believe in the integrated approach to humanitarian demining. Demining, mine awareness and victim assistance are all aspects that should go on simultaneously and all be incorporated for humanitarian demining to be successful. How does RONCO, which specializes in only one aspect, navigate this approach?

Crandall: Integrated development, which is what your talking about, is a concept that has been played with in the development world for about 30 to 40 years. It is rather long of tooth. Many of the NGOs have taken on this integrated approach as a sort of mantra. There are better and more proven approaches. Trying to integrate all aspects under one organization just can't happen, and, if it does, it is under extraordinarily high cost. We found, as an institution and myself as an individual, that comments about integrated mine action are suspect. Traditional integrated development practices arose from different development experiences than demining in post conflict situations. While the client rules, we prefer to market simpler, cheaper and demonstrably workable solutions.

Edelmann: It is one of those concepts that sounds great. Why don't we just integrate everything? The integration factor becomes the goal, and you lose sight of everything that you are trying to get done and accomplish—like saving lives.

Crandall: We are in the development business and started as a development business. We added demining in 1989. Demining is demining, as far as we are concerned. We build private sector enterprises, and we undertake agriculture and other development projects. We see demining as a tool to open the door for education, agriculture and other sectors. You are looking at people that did it for over 30 thirty years, so we are talking from experience. The people who depend on us to make their farm fields and schoolyards safe would lose if we tried to integrate. Grafting dissimilar elements onto each other, while attractive in the abstract, in our experience, isn't the best approach in many, if not most, demining situations.

Edelmann: Remember, you are looking at a company that has been and is involved in a number of development programs.

Crandall: Now, in the terms of demining, you are integrating safety, medical, technology, and dogs

When a mine detecting dog is first deployed, it must initially work with the handler to whom it bonded in training.

Photo c/o Tony Allen/ RONCO

[and] funding. If you want to call that an integrated approach to demining, that is what we do. That is already a complex package.

How did RONCO get into using dogs as their primary focus?

Crandall: RONCO got started with dogs in Afghanistan. During the Soviet invasion, to take equipment into the country would have meant the Soviet airplanes would have destroyed it. You needed a technology that would not draw a lot of notice to what you were doing. We knew that the U.S. Army had spent a great deal of time working with the Thai army, who was working with dogs in demining along the Cambodian border. We needed a low cost, efficient technology, and dogs were the answer. We contacted the Thai army and negotiated to pick up their handlers and dogs and flew back to Pakistan in what was then a covert operation.

Lundberg: Dogs are just one important part of our tool kit. We are using flails and other equipment to clear vegetation. There is a perception around the world that RONCO is dogs. That is true, but it is only one element to our operation. Whenever possible, we also integrate manual deminers and machinery.

There is a lot of debate regarding dog use vs. manual demining. Many people are suspect of dog use in demining.

Crandall: We assume you are referring to productivity. We don't agree with that. Handicap International went into our operation in Afghanistan and took a look at our data on dogs. In the worst case, dogs were found to be twice as effective as manual demining alone. In the best case, it was 20-30 times more effective. We are finding that demining is faster and safer using dogs. In some cases, like in Bosnia with the plastic mines, the metal content is so low that a metal detector can't find them, but you can with the dog because they detect explosive vapors.

Edelmann: Also, our dogs are trained on trip wires. There are not any other dogs in the world trained on trip wires. The way we train our dogs and handlers is unique. It remains the best approach from our perspective. Like explosive vapor signatures, tripwires create an acoustical signature that can be detected.

Lundberg: Invariably, when we hire a new deminer, the dogs may put them off. After working with us, they won't go into a mine field without a dog.

Edelmann: How do you demine a reinforced concrete bridge or building? Detectors are essentially useless. An integrated team of manual deminers and dogs, in our experience, is the most cost effective, safe and speediest method.

Lundberg: You have to remember there are RONCO dogs and other dogs out there. The mine-detecting dog is becoming more popular, and other dog outfitters are starting up because of the success of RONCO. We have seen those dogs, and we have been called in to retrain those dogs. And that is not to say that other companies' dogs are bad. There are some good ones, but there can be a big difference in dogs.

Can you tell me about the Integrated Mine Action Support or the IMAS contract?

Lundberg: We can talk about IMAS from RONCO's point of view, but we encourage you to talk to the State Department because we want to make it clear that we don't represent the U.S. government. There was a perception out there about this contract that, to some extent, may still exist. I had a number of NGOs sitting at this conference table to talk about the IMAS contract who were rather upset. It was perceived that RONCO suddenly had $250 million, and people wanted to know: Were we going to be sharing any of that money? That was everyone's opening remarks. They didn't understand what that contract was and is. The IMAS contract is an indefinite quantity type contract in that [the] State Department tells RONCO what it wants done via task orders. RONCO is not controlling this money or [the] identification of the tasks. The State Department is giving us our guidance, our tasks and what they want us to do. Some of those tasks involve procurement of demining equipment only. There are probably over 50 tasks since we started in September 1999. Other tasks involve services we are being asked to provide. Right now, we are in Kosovo; we have six demining teams primarily picking up cluster bombs. We are going into the Kosovo-Albania border with two fully equipped teams for the next five months. We are going into Oman to develop a mine detecting dog capacity, which will be integrated with their demining programs. We do whatever the State Department directs us to do. We give them a written response to their task order request. Then we sit down and negotiate about the task order. In a few weeks, we are usually mobilized to action. We are putting a study team in Lebanon, as we speak, that is going to work on the efficiency of a mine dog program in Lebanon.

What is RONCO planning for 2000?

Lundberg: We are hopeful the World Bank will reappear. Not a lot has come out of the World Bank in the last few years. Its financial strength and relative influence make it a potential strong partner. The World Bank has taken some time off from demining but may be getting back into it, and, if that is the case, we will be bidding for those options.

Do you use any specialized Personal Protective Equipment (PPE)?

Lundberg: We deal with Second Chance, a U.S. firm that specializes in this [Personal Protective Equipment]. We have had them design specific RONCO designs like the blast collar, which is a little higher and deflects the blast.

Crandall: We just introduced into the Balkans a new helmet, which is really just a visor. The visor wraps around and decreases the need for a helmet, which can be very hot. That little bit of a change improves a deminers effectiveness by 15 or 20 percent. We are always trying to make the deminers' equipment better.

Is there anything else you would like to mention before we close?

Lundberg: I would like to mention that in all the years that RONCO has been in demining, we have only lost two people to accidents. I don't think that you can find anyone who has been doing it this long that can say that. A big factor is the dogs. Safety is a major factor with us. We are very careful with the deminers we hire. They have to forget the cowboy attitude and work with RONCO's operating procedures; otherwise, they can't work for us. It pays off for us. We carry extensive insurance on our deminers, but, even so, our rates are low because of our accident rate.

Founded in 1974, RONCO Consulting Company is an international professional services firm with extensive knowledge in a wide range of development issues. Along with humanitarian demining, RONCO specializes in privatization and private enterprise development, agribusiness and procurement services. In 1999, RONCO won the open competitive bidding for the IMAS contract sponsored by the Humanitarian Demining Programs Office in the Political-Military Bureau of the Department of State. ■

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In general, dogs are fully effective at finding explosives 10 centimeters below the surface. Neither dogs nor detectors can easily find mines under 30 centimeters of heavy clay soil.

Photo c/o Tony Allen/RONCO

MOZAMBIQUE: A Country Ravaged by Civil War and Nature

by Stephanie Schlosser and Virginia Saulnier, MAIC

Mozambique, a nation fraught with the aftermath of civil war and, more recently, torrential downpours devastating the countryside, has attained sufficient stability to attempt the mammoth task of reconstructing its social and economic foundation. After suffering through 16-20 years of civil war, which eventually subsided in 1992, Mozambique's demining efforts were progressing when the nation was struck by Cyclone Eline in late February 2000 and Cyclone Hudah in mid-April 2000, complicating the demining mission. Initial reports indicated that mine fields that had been previously mapped for clearance had suddenly vanished, as the violent storms swept the mines to unknown locations. This movement caused demining specialists to fear that the exposed and/or shifted landmines would make rehabilitation increasingly more dangerous for the Mozambican people. Though the shifted mines were an initial fear, later reports debate the severity the displaced land mines pose to the rehabilitation efforts.

As demining activities were postponed until the flooding ceased, mine awareness campaigns have become more important in Mozambique. Confronted with the overwhelming reconstruction task, civilians now face the possibility of encountering "new" landmines. Not only is the population in the midst of rebuilding its country—repairing damaged roads, bridges, schools and infrastructure—but now Mozambique's demining teams must also conduct new surveys and redraw maps to pinpoint the shifted mines.

The Landmine History

During Mozambique's civil war, government soldiers and rebels scattered mines indiscriminately, rendering vast portions of the country virtually uninhabitable. After the conflict, landmine accidents numbered at approximately 40 per month. On average, 15 of these accidents were fatal. Currently, a total of 7,000 Mozambicans have been fitted for prostheses—a number the Mozambican people do not want to see rise.

Presently, the United Nations believes Mozambique is one of the most heavily mined countries in the world. As records were not officially kept during the war, there is a large degree of uncertainty concerning the number of planted landmines; the reported numbers range from 400,000 to five million. Prior to the flooding, deminers had mapped much of Mozambique to assist the mine clearance efforts, and since 1994, deminers have removed approximately 18,000 mines. These maps also enabled government officials to warn citizens of unsafe areas.

Three U.S. Black Hawk helicopters from Rescue Squadron 41 based at Moody Air Force Base, Georgia, arrive with rescue crews at Beira Airport, Mozambique, Thursday, March 9, 2000, to help in the aid and recovery efforts following the devastating floods.
Photo c/o AP/World Wide Photos

Unfortunately, the rains have derailed mapping efforts. Deminers' efforts must begin anew, returning the focus from mine clearance to mine assessment once again. Another disturbing fact is an increase in the mine count, as floodwaters may have unearthed previously undiscovered mines. Jacky D'AlMeida, director of the Mozambique Demining Program, stated, "We were beginning to see the light at the end of the tunnel. No one knows where the mines could be today."

Flooding Aftermath

The initial floods from Cyclone Eline tearing through Mozambique forced over 450,000 people from their homes and possessions and killed an estimated 500. CNN news reports indicate 160,000 civilians were displaced from Chokwe, Xai-Xai and Chibuto. Specialists believe that the floods likely pushed the mines to these high-density areas, resulting in another complication in the rebuilding and demining tasks. Furthermore, the floodwaters could take up to six months to completely recede, lengthening the detection and mapping process. One CNN news report estimated the cost to demine Mozambique at three million dollars, money the country obviously does not have to spare after the disastrous after-effects of Cyclone Eline.

After struggling to pick up the pieces Cyclone Eline dispensed, Mozambique suffered another twist of fate when Cyclone Hudah struck in mid-April, hampering the humanitarian and demining efforts. Though the storm did not register as severely as Eline, Mozambicans were hardly prepared to endure another cyclone in the midst of rebuilding their impoverished country.

Mozambicans must now approach the reconstruction task with the utmost caution, as they are unaware of the precise location of the deadly devices. Uncertainty consumes every aspect of these people's daily routines. Landmines do not expire. Many relief organizations are unable to provide extensive assistance, as their supply trucks are not built to withstand a landmine explosion. Mozambicans face a dire situation: they are unable to return to their homes, farms or work, resulting in severely limited incomes for people whose country's economy has suffered the worst at the hand of nature. The majority of the population lacks access to safe drinking water, food resources and medical facilities, and the floods have created a shortage of many essential items. In turn, this shortage has caused the prices of these items to skyrocket, which does not correlate with the restricted incomes of many Mozambicans.

Challenged not only with reconstructing their homes and communities, Mozambicans now also face multiple physical ailments. UNICEF officials have emphasized the outbreak of diseases that typically occur after massive flooding to include malaria, diarrhea, measles, meningitis, dysentery and respiratory infections. In a country where only 46 percent of the total population has regular access to safe drinking water, the majority of Mozambicans are now forced to subsist on contaminated rainwater, which can induce these severe diseases.

Humanitarian Action

To return the country to its previous economic status, the local population and humanitarian organizations must take action against the devastating effects Cyclone Eline left in its wake. President Joaquim Chissano of Mozambique has beseeched the international community to forgive its foreign debts. Prior to the flooding, Mozambique was experiencing a significant economic increase, as the economy was growing at an annual average of 10 percent. For a country whose reputation of poverty has dominated its existence, Mozambique appeared to be on the road to recovery when Cyclone Eline ravaged the countryside.

Because of the immediate need for villagers and farmers to return to their communities, the United Nations must redouble its Accelerated Demining Program (ADP) efforts originally begun in 1992. While landmine related fatalities had been steadily decreasing since the program commenced, demining teams fear this number will again rise as people will be unaware of the location and counteraction to take against the shifted landmines. Indigenous populations inhabiting previously cleared areas must now remember and relearn the appropriate procedures when encountering a landmine. Therefore, increased monies must be allotted to fund mine awareness campaigns to educate Mozambicans of the dangers of landmines. Mozambique urgently requires monetary donations and equipment to prevent a 10-year economic setback.

President Chissano also has implored humanitarian organizations, primarily the U.N. Development Program (UNDP), for monetary assistance to rebuild his devastated country. The UNDP estimated that a minimum of $450 million (U.S.) is needed to rebuild the homes, schools, hospitals and roads demolished by Cyclones Eline and Hudah. UNICEF has donated $1 million in educational and mine awareness supplies for the 30 schools Eline destroyed and has offered technical guidance in planning, monitoring and coordinating Mozambique's government agencies in rebuilding the nation's infrastructure.

The UNDP has indicated several categories of emphasis for a portion of the estimated $450 million. It has assigned $120 million to rebuild transportation systems, $63 million for agriculture, $26.6 million for administrative costs, $38.1 million for industry and $15 million for disaster control.

In addition to the monetary support, Mozambicans have found themselves in dire need of medical supplies. UNICEF is currently shipping essential medicine and safe drinking water in an effort to combat the outbreak of disease. They have also begun a national communication campaign aimed at preventing the spread of diseases.

Conclusion

The rippling aftereffects of Cyclones Eline and Hudah have beaten mercilessly at the heart of this devastated country. Only time and financial assistance can return it to its previous state. As displaced Mozambicans are slowly trickling back to their homes and communities, starting to rebuild their lives and towns, they must do so cautiously. The financial assistance and donated supplies Mozambique so desperately requires will enable Mozambique's demining efforts to continue, eventually ridding the country of its horrendous and life-threatening problem and returning it to a state of economic stability and growth. ■

International Standards...

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tests is required to determine the efficacy of blast-resistant mine boots and to judge their place in humanitarian demining operations.

Requirement(s): PPE is the final protective measure after all planning, training and procedural efforts to reduce risk have been taken. Deciding appropriate PPE depends heavily on local SOPs and should be the subject of an iterative risk reduction exercise using a formal process as set out in ISO Guide 51. A realistic minimum standard for PPE is that capable of withstanding the effects of blast and fragmentation mines.

Formal Evaluation: There is a need to encourage the formal trials of PPE available for use in humanitarian mine clearance programs. Such a trial should be conducted under strictly controlled and repeatable conditions using criteria that agrees with the field user community. Ideally, this trial should be conducted with U.N. approval and taken as a priority project by the recently formed International Test and Evaluation Programme (ITEP). The results should be made available to MACs and demining entities in the form of a consumer report.

User Trials: User trials complement formal testing and evaluation. They serve two purposes. First, they provide a means of testing *locally* manufactured or locally modified PPE against *local* threats without involving the cost and complexity of a formal international trial. Second, they provide *local* demining entities with immediate and sometimes more appropriate results under *local* test conditions. They encourage *local* confidence in the effectiveness of PPE.

Blast: PMN mine detonating during demining in a squatting/kneeling position:

- Frontal protection, coverage appropriate to the activity, capable of protecting against the effects of a 240g of TNT at 30cm from the closest part.
- Eye protection equal to that offered by 5mm of untreated polycarbonate, capable of retaining integrity against the effects of 240g of TNT at 60cm, (providing full frontal coverage of face and throat in conjunction with jacket/apron).
- Hand protection integrated into the appropriate design of hand-tools. The tools should be designed to be used at a low angle to the ground, provide at least 30cm stand-off from an anticipated point of detonation, and be constructed in such a way that their separation or fragmentation in a blast is reduced to a minimum and include a hand-shield whenever possible.

Fragmentation: Ballistic protection of "secondary victims" must be provided against the local fragmentation mine threat. It is generally acknowledged that tests for ballistic protection do not realistically replicate mine effects. Until an accepted alternative is developed as an international standard, the effects of a fragmentation hazard should continue to be evaluated by the STANAG 450 m/s V50 test or by independently verified user trials (involving at least three articles of equipment) tested at the safe working distances defined in local SOPs.

Conclusion

In examining the vital demining issue of PPE and its effectiveness, it's crucial not to overlook outside factors. While the study of PPE certainly must focus on its adherence to international standards, durability in the field and proper usage by deminers, through efforts like those of the WGPPE, these factors are integrated with other vital forces. These forces include environment, threat and supervision, among others. When all factors are considered, the most efficient and, above all, safe approach toward reducing risk is revealed. Also, not to be overlooked are industry practices outside the realm of demining. If SOPs are to be improved, the demining community may need to look no further than other successful risk-laden industries. The end result of an intelligent and comprehensive study of PPE and its surrounding influences will inherently address issues such as the effects of primary and secondary fragmentation, threats from lesser detectable mines and areas of the body most at risk. But only through examination of the broader picture can those issues that hit home the hardest be understood and corrected. ■

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Central America Landmine Survivors:

THE NEED FOR ACTION IN NICARAGUA

by Dr. William Boyce,
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Introduction

Landmines are indiscriminate weapons, wounding and killing not only soldiers but women and children as well. Although hostilities may cease, landmines continue to maim and kill 500 victims a week, the equivalent of 26,000 additional disabled persons each year. There are at least 250,000 landmine-disabled people in the world, and the number continues to grow.

The landmine issue will not end with the signing of a comprehensive treaty on anti-personnel landmines. There are complex problems in detecting and removing landmines, in preventing further injuries and in assisting disabled persons and disrupted communities to reconstruct their social, economic, political and civil infrastructures. Since landmines and other unexploded ordnance have serious inter-sectoral consequences for the reconstruction of war-torn societies, especially in developing countries, they are best addressed from a development perspective, which ensures due regard for the principles of equity, capacity building and sustainability. These principles suggest that the landmine-injured and war-wounded should not be segregated nor receive services which are inaccessible to the general population of disabled persons. This could be socially, and possibly politically, divisive.

A deminer, outfitted with plastic visor, carefully prods the ground. Rivas, Nicaragua.
Photo c/o Will Boyce

Nicaragua

Nicaragua has the most serious landmine problem in Central America. Since the war ended in 1989-90, there have been a series of demining programs and a national rehabilitation policy has been partially implemented.

Approximately 100,000 mines (out of an original 130,000) remain in Nicaragua. The principal areas of mine concentration focus on the Matagalpa area, which had intense fighting, and Chiandega, which had 106,000 sq. m mined, especially near the Central American hydro-generating plant. Chiandega's northern border of Honduras has 106 out of 206 km still mined and its southern border with Costa Rica has 16 out of 235 km mined. The central area of Nicaragua (Esteli, Jinotega) has 318 mine sites, representing 206 sq. km, and other areas of heavy mine concentration. Unexploded ordnance is also a major problem.

Deaths and Injuries

A reliable system for documenting landmine-related deaths and injuries does not exist in Nicaragua. Available information, which includes only those injuries that are reported to the police or to a prosthetic service, must be considered as rough estimates. Health post personnel in the rural areas are not required to report the cause of an injury. In some rural areas where there are no authorities (health, hospital and educational), people do not feel that they will be helped if injured, so they do not report incidents. The Nicaraguan military reports that from 1987 to 1997, the civilian population had 46 deaths and 470 disabilities from landmines while the military had seven deaths and 88 disabilities.

Overall, landmine injuries are fewer now than during the war (93 percent occurred prior to the peace settlement). However, more civilians and children have recently been injured. ICRC sources indicate that there are approximately 80 civilian mine incidents a year, mostly involving children who are particularly susceptible to playing with landmines. For example, during the 1996 Christmas holiday, eight children were injured throughout the country in separate incidents.

Thirty percent of landmine injuries are severe, involving multiple body systems and long term disability while 70 percent require simple amputation or cause vision problems. In mine incidents, approximately 20 percent die and the rest survive with at least an amputation and often injuries to the face, eyes, ears, chest and genitals.

An Italian NGO, MOVIMONDO has operated a program for six years and has direct contact with 7,000-8,000 war-injured persons, 15 percent of whom are prosthesis users. Their staff believes that there were at least 26,000 persons injured in the conflict. This estimate may be an under-approximation, as it may not take into account accidents that occur in remote areas.

NGO sources note that the overall magnitude of disability is very large in Nicaragua (approximately 12 percent of the 4.5 million population), but conflict has been only a part of the problem. For example, the principal cause of civilian amputations in 1997 was diabetes, but there are few reliable statistics.

Need for Action

The landmine problem in Nicaragua is severe, requiring action in demining, awareness, rehabilitation and reintegration. Although there is a formal government rehabilitation plan, it appears to be overwhelmed by the magnitude of need. A principal problem is that the national rehabilitation program has limited financial resources for health staff, for the recurrent costs of prostheses and for job placement programs. A second problem is a lack of rural community confidence in the government system and apprehension in accessing it. Finally, there is considerable dysfunction in the families of disabled ex-combatants due to altered social roles after years of fighting and disablement.

Facing these challenges, there is an existing network of NGOs and institutions which are already cooperating and providing a basis for programming. NGOs with established programs in rural areas could cooperate in community based rehabilitation (CBR) programs, which provide disability detection and re-

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ferral as well as a practical transfer of functional skills to disabled people. This approach would improve access to basic rehabilitation services for the isolated, rural poor and provide an alternative where government services are limited.

Existing Ministry-supported health post personnel and brigadistas could also be recruited to provide basic rehabilitation services, building on the tradition of voluntary action. Multi-disciplinary teams could provide basic rehabilitation skills and training to health workers and volunteers, building up the CBR policy initiative of the government.

Prosthesis

The supply of prostheses is adequate, although accessibility to this service in rural areas is hampered by the lack of a distribution system. Decentralization of the system from Managua to the regional level is possible by using modular components as much as possible as well as mobile repair units.

A principal problem in Nicaragua concerns the affordability of prostheses. Agencies feel they are keeping up with demand, yet they do not receive requests for prostheses because clients have become aware that they cannot afford them. Rural disabled persons are unaware of charitable financial support for purchasing prostheses. Private sector involvement, perhaps on a regional basis, could lower the costs of prostheses significantly. Specifically, the costs of prostheses could be lowered by increasing the number of modular components. For example, the foot section could be produced and distributed on a regional basis. This may improve the affordability for the average Nicaraguan, especially for families of child amputees. At the same time, increasing the ability of persons to pay for prostheses themselves, either through NGO savings or credit programs, is necessary. It is advisable to do estimates of lifetime costs for prostheses, considering the need to replace them at least once every five years.

Reintegration

Initiatives for economic reintegration of disabled persons are extremely difficult in the current economic context. Nonetheless, disabled persons should not face additional attitudinal barriers due to their impairment in finding employment. Integration is needed, but there is no national group with this experience. Development of a local disabled people's organization with skills in advocacy and public relations would be useful in this process. These groups could also develop local savings and loan programs for prostheses and micro-enterprises.

Mine-awareness programs need to address the continued use of landmines for on-going conflict, revenge and land protection. Demonstration projects for isolated groups, such as the Organization of American States Program, are excellently focused and targeted programs which provide service to the most needy. They serve a strategic purpose of demonstrating to both the bureaucracy and the rural population that something can be done. Finally, the International Committee of the Red Cross Child Landmine Awareness programs is a viable approach and should be replicated in these remote areas.

National Rehabilitation

The presence of a national rehabilitation plan in Nicaragua indicates that disability has attained a certain priority in the country. The Nicaraguan Ministry of Health is currently working with PAHO on a disability information system. However, a multi-institutional (civilian, military, social security and private) and multi-sectoral approach (Health, Education, Labor and Defense) is required to implement the national rehabilitation plan for more effective coordination of NGOs, government funded institutions and disabled people organizations. Furthermore, policy refinement and key demonstrations of capacity in rehabilitation are required so that the Nicaraguan government has a solid consensus to proceed with rehabilitation development within the country.

Discussion

The short-term emergency aspects of large-scale landmine and war injuries have decreased in the Central American region in this post-conflict period. Nonetheless, three significant long-term trends are particular to the context of war-related injuries. First, major traumatic musculo-skeletal injuries often require life-long rehabilitation input; amputation is an excellent example. Second, successful socio-economic reintegration of disabled persons, both combatants and civilians, requires both public acceptance and a healthy economic environment. Third, mental health problems in affected persons are often unrecognized needs which underlie the failures of rehabilitation at individual and community levels. These needs are complex and interactive in Central America, and they

ICRC has supported Nicaraguan victims and vicitim assistance.
Photo c/o Will Boyce

require a comprehensive development approach which does not privilege the war wounded above other disabled persons but which allows their urgent needs to be met.

Institutional Linkages

Disability, because of its need for both personal change and social adaptation, demands a multi-disciplinary, multi-institutional and multi-sectoral approach. Management of disability problems requires interaction and negotiations between service agencies and can create opportunities to reestablish the basic philosophy of social service and economic reconstruction.

The Nicaraguan government is concerned about the needs of landmine-injured persons and recognizes the political impact of continual reminders of former conflicts. Government links to local community organizations and beneficiaries are partial with little penetration to rural areas, especially those on border regions where landmines are most pervasive. Government coordination of rehabilitation services varies considerably, even though Nicaragua has a formal rehabilitation plan. In practice, the implementation of rehabilitation services is lacking due to a scarcity of trained personnel, continuing economic restrictions and a clear geographic bias towards urban settings. Some ministries (Health, Social Security and Labor) are linked in order to address cross-sectoral concerns; however, the maintenance of four separate hospital and rehabilitation systems (general public, military, social security and private) wastes scarce resources. This duplication results in unequal access for those most in need. Nicaragua relies heavily on services provided by the NGO sector, yet at the same time, separate private services are available for those with sufficient resources. There is some coordination across these systems, yet it is unfocused.

Sustainability

The adequacy and stability of financial resources in Nicaragua to fully support the long-term rehabilitation needs of injured persons are modest. An emphasis on reducing costs of services by technological innovation and training less expensive rural health personnel should be combined with developing en-

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trepreneurial skills among beneficiaries and utilizing community savings and loan programs for ongoing equipment costs.

The quality and stability of rehabilitation personnel are adequate, even though the numbers are few. However, caution must be taken in training professional staff outside Nicaragua. Sufficient incentives and controls must be utilized so that trained rehabilitation staff return to practice. This requires the formal allocation of positions to rehabilitation in rural areas. Even with an increased number of trained staff, the demands on these personnel to be involved in planning and program development will escalate. Sufficient training in program planning, evaluation and policy development is also required to supplement their clinical skills.

The NGO sector has significant support from the public and has been only partially mobilized in the landmine survivor assistance issue. NGOs could be more fully integrated in areas of public education, primary health care, vocational training and public advocacy.

Post-Conflict Peace Building

During post-conflict periods, the increased prevalence and visibility of physical injury from conflict is a constant reminder that peace is crucial, yet at the same time, it can engender resentment if needs are not met. The situation in Nicaragua creates an opportunity to heighten the profile of disability on the humanitarian development agenda. If action is taken to catalyze sufficient resources to address these needs, disability can become an issue common to divergent groups, which evokes a sense of common purpose and an openness to develop a strategic vision for community based peace building initiatives. Action on disability can provide both symbolic and tangible catharses to factions, to donor agencies and to civilian victims of conflict, which can diminish perceived barriers between disparate groups.

Regional Cooperation Issues

The countries in Central America differ greatly in their history of conflict, degree of medical rehabilitation, socio-economic infrastructure development and size and scope of conflict-related disability problems. There are, however, common conditions of physical security, economic under-development and social reintegration issues which can all be attributed to the landmine problem.

Opportunities for increased regional cooperation of Nicaragua in Central America should include considerations of economies of scale, non-duplication of technical services and optimizing the benefits of learning from each other's experiences. Discussions have often focused on a regional approach to prosthetic services, and there has been considerable enthusiasm for this idea. There are different skill levels across regions and within countries, different institutional eligibility requirements for prostheses which affects affordability and can create potentially serious problems with regional communications and the timely transport of prosthesis sockets. Nonetheless, regional functions in prosthetic services could include elements such as prosthetic design, modular component production and service evaluation. Prosthesis assessment and measurement, production/assembly, fitting/trials and repair should probably best continue as local functions. Other more likely areas of regional cooperation concern the development of CBR educational materials, public relation materials concerning economic re-integration of ex-combatants, mine awareness strategies for remote, isolated areas and micro-savings models. ■

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WWII Ordnance Still Haunts Europe and the Asia-Pacific Rim

by *Margaret Busé*, MAIC

Explosives and mines from WWI and WWII still turn up on European and Asian construction sites, backyard gardens, beaches, wildlife preserves and former military training ground. For most countries, these discoveries are not isolated incidents but are the result of hastily cleared ammunition dumps, training ground, bombings and mine fields from these wars. In the United Kingdom, over 20 percent of the entire landmass has, at one time, been used for military training. This military training has resulted in uncovered ordnance that dates from cannon and musket balls to modern weapons. Many of the older U.K. ranges can contain an entire historic sampling of ordnance. Clearance of these areas is a priority because it is being returned to private ownership and must be confirmed "free of ordnance" under current laws.

In Belgium and neighboring countries, 80 years after WWI, the Bomb Disposal Unit (BDU) of the Belgium Armed Forces finds about 10 WWI UXO every day. Bombs Away, a private hazardous material firm specializing in UXO removal in the Asia-Pacific Rim, unearths WWII UXO daily. According to Manfred Schubert, chief of Hamburg, Germany's UXO department, Germany has enough UXO littering its landscape to keep the department busy into the 21st Century. This UXO includes hand grenades to 500 pound chemical long delay bombs. Even after the guns of these wars have fallen silent and hobbyists and antique dealers trade on their history,

Country	Chemical Ordnance		Non-Chemical Ordnance		Total	
	Number (Thousands)	%	Number (Thousands)	%	Number (Thousands)	%
Germany	33	6.4	485	93.6	518	35.6
France	16	4.6	334	95.4	350	24.1
UK	4	2.2	178	97.8	182	12.5
USA	1	12.5	7	87.5	8	0.5
Russia	3	4.2	69	95.8	72	4.9
Austria	5	2.9	170	97.1	175	12.8
Italy	4	2.7	146	97.3	150	10.3
TOTAL	**66**	**4.5**	**1,389**	**95.5**	**1,455**	**100.0**

Chemical and Non-Chemical Ordnance Released by Allied and Axis Countries
Table 1

Due to more than 90 years of live firing at various locations on Dartmoor, explosive ordnance contamination from many countries covers most of the Tors. Due to an accident in June 1995, when two children were seriously injured by a two inch HE mortar, and due to pressure from conservationists to reduce the danger areas so they have more freedom to walk the Tors, 5 Section EOC was to begin the mammoth task of clearing Dartmoor.

Photo c/o Redwing Magazine

battles are still being fought. Ordnance contamination continues to plague these countries.

The high rate of failure among the ammunitions from 60-90 years ago is cited as one of the main reasons for such a high level of contamination. Some specialists estimate 30 percent of ammunitions never exploded. Sgt. Robert Hallam, a bomb disposal officer with the U.K. 33 Engineer Regiment (EOD), feels that so much UXO is being removed from the U.K. because of the high bombardment level during WWII. He said, "You must also take into account the failure rate of this equipment. Nowadays, we expect 10 percent of submunitions will fail and that is with modern technology at work. The armed forces of that era simply did not have as much time to deal with misfires or blinds as they would have liked."

Captain Vincent Muylkens of the BDU of the Belgium Armed Forces (SEDEE-DOVO) feels "about 450 million pieces of explosive ordnance remain. Having 3,500 requests each year, we will stay busy for many years to come." Michel Lambrechts, captain-commandant of the unit commented, "every year we handle approximately 250 tons of ammunition from these wars. Within these 250 tons, some 20 tons are doubtful ammunitions which could be chemical shells from WWI."

Paul Murray, president of Bombs Away said, "the Pacific Rim was the scene of fierce fighting during WWII. Millions of ordnance items with a 25 percent dud rate were extended from the Marshall Islands to Japan. Southeast Asia experienced even more war with ongoing conflict through the '70s. With increased development of the Pacific Rim, these items are unearthed every day in excavation areas throughout the former battle sites." U.S. military EOD teams deal with over 225 emergency UXO calls on Guam per year. Murray feels that even more ordnance is unearthed in excavation sites than are reported. It is then returned to the fill site out of ignorance or complacency. "On Kwajalein, the amount of UXO recovered from excavation sites went up 1,000 percent when those sites were monitored by UXO specialists," he explained.

Saipan, a 46 square mile island near Guam, was the scene of one of the key battles of the pacific war. On June 15, 1944, U.S. forces staged amphibious landings along its coast against well-established Japanese defenses. By the time the battle officially ended on July 9, 1944, approximately 30,000 Japanese soldiers and civilians had been killed, including over 4,000 who died in the battle's single largest Banzi charge. The United States suffered 16,525 casualties and 3,426 deaths. Saipan was also infamous for the mass suicide of over 10,000 Japanese civilians who threw themselves and their children off Banzi cliff. Today, the small island is still under the curse of the WWII battle. Northern Marianan emergency management officials believe there are still tons of UXO scattered across the small island today. Marpi, most of which is now forested, was the site of the last Japanese stronghold. It is so concentrated with UXOs that efforts to clean up the site have been hampered by the cost of the enormous undertaking. Beach combing a UXO while walking the shoreline is not uncommon. Road and construction projects are often delayed. The government occasionally hires a contractor to deal with the problem, but there is no organized ordnance disposal in current governmental plans. Officials feel the task would be too costly and may take many years. Adding to this dilemma is the bureaucratic red tape for undertaking such a job. The outlook for development in Saipan and the rest of the Northern Marians Islands is not optimistic, as these weapons stay indefinitely volatile.

The History of Clearance-The History of Warfare

The history of clearance and military warfare may be part of the answer as to why so much UXO remains littering these islands and Europe. Clearance of UXO and land mines has dramatically improved over the past 10 years. Previous to humanitarian involvement in demining and UXO removal, various military branches undertook these tasks. Before 1939, little organized clearance was taking place, and any items found were dealt with on an item-by-item basis.

From Caesar's ancient forms of traps and spikes of the caltrops to the fougasse, early attempts at landmines proved unreliable, time consuming and secondary to the main weapons and defense system. The U.S. Civil War precipitated the introduction to pressure operated mines. Brigadier General Gabriel Rains of the Confederate States Army had been experimenting with artillery shells to explode by trip wires or a false step. The use of these explosives began on a limited basis but not without controversy. General William Sherman of the Union Army stated that landmines "were not war, but murder."

During WWI, AP mines were adapted from artillery shells, and the Germans developed the Minenerfer shell fitted with a chemical fuse that detonated the device up to and beyond 48 hours. These UXO are still found today. By WWII, the mine had become effective in military uses and economically efficient by delaying, rechannelling and damaging armor and men while requiring less manpower and material to hold offensive and defensive positions. The effective use of mines during WWII encouraged their continued use and technical development as a standard weapon of war.

Clearing mines and UXO during both World Wars was a monumental undertaking, especially by countries that were devastated financially, economically and politically. The WWI Armistice Agreement of 1918, required the Germans to report their mine field plans and location of delayed action charges. During WWI and WWII, the Germans laid mines in a uniform pattern, and they were marked and recorded. Even so, as in the case of North Africa, only modest efforts were made to remove the mine fields laid by German Field Marshall Rommel.

During WWII, efforts were made to clear some mine fields. The U.S. 20th Engineer Regiment was ordered to clear the Sedjenane Valley in Tunisia. They removed 200,000 mines, but demining was very unpopular. "Virtually everyone objected. Why? The fields had no military value; they were only worked by Arabs. Removing mines was enormously difficult and dangerous, and the mines were in thick brush and scrub that would only be trod on by [civilians] and beasts. Almost everyday there were casualties. Seven officers and nineteen men were killed because someone thought it was a good idea to clear the Sedjenane," reads an account from Mike Croll's *The History of Landmines.*

Clearing 20,000 mines in the Formia-Gaeta area north of Napels, Italy, resulted in 15 fatalities and 42 injuries. The French employed up to 49,000 POWs to clear mines throughout Europe and the former Soviet Union. Between eight and 17.5 percent of POW deminers were killed during 1945-1946. "The

POWs were given a strong incentive to ensure that all mines were removed; they were required to march shoulder to shoulder across any area that they cleared," writes Croll. In August 1949, the Geneva Convention eliminated the use of POWs for demining.

The beaches of Great Britain also proved difficult to clear, particularly when dealing with tides and shifting shorelines. Approximately 350,000 mines in 2,000 mine fields needed to be cleared. The last mined beach at Trimmingham was finally opened to the public in 1972. The beach mines proved to be devastating to civilians. One Dorset beach was declared safe and open to the public, but it proved fatal to five schoolboys who played with a mine that they found. There, beach clearance was carried out by the Royal Engineers and Ukrainian prisoners of war. Between 1945 and 1957, 155 deminers were killed and five injured.

Clearance of UXO is still a problem and hampers development in many of the aforementioned areas. Headlines report old bombs turning up on construction sites. Japan's Ground Defense Forces recently defused a bomb that was dug up during construction of a shopping center. In Penang, Indonesia, in 1996, 105 UXO were discovered in various locations. In 1997, a 110lb. shell believed to be from the Battle of Stalingrad was discovered on a Russian soccer field. In Germany, the ordnance department currently has 2,000 workers covering the entire country for UXO because of the frequency at which UXO are still unearthed.

Hamburg was especially devastated during WWII. In one three-day bombardment in July 1943, Allied planes unloaded 8,000 tons of bombs. Hamburg's still pockmarked landscape reveals numerous bomb craters. Specialists watch the rim holes of these bomb craters because a well-trained eye can make out the discoloration that may reveal an unexploded bomb. Schubert, Hamburg's bomb disposal expert stated, "other parts of Germany have bigger headaches than we do." Oranienburg was the site of more than 20,000 dropped bombs as well as booby-trapped bombs with time fuses. Since 1983, three such bombs have self-detonated.

Sgt. Hallam and Spr. Parker, place CLC.

Photo c/o Redwing Magazine

Muylkens reported, "There are ammunitions all over this country, but we don't have any mine fields left. We are dealing with all types-aircraft bomb, artillery shell, mortar bomb, rockets, sea mines, grenades and sometimes chemical weapons. In some countries, these WWI and WWII UXO problems are still an obstacle to development." In Libya, as late as 1980, 37 percent of the agricultural land was still unusable because of mines and ordnance from WWII.

Hallam feels there is so much UXO littering the U.K. because it was "one large training ground. Most of the areas we tend to work in are the more in-hospitable parts of the country. For obvious reasons they were chosen: 'Train hard, fight easy,' and are places like Dartmoor, Yorkshire moors, Wales. Large bombs also appear in London or areas where they were dropped in abundance." The largest problem for U.K. EOC operators is that much of the area to be cleared is still unknown. Countries dealing with old ordnance also encounter this problem. In areas used for training, the boundaries were often not recorded. There were no written records of experimental training sites. Ordnance dumps and ordnance stores were often not known by many people. For instance, in the United Kingdom, only two to three men knew the location of these sites. Defensive positions were heavily mined and the majority of these were often hastily cleared. To search an old mine field to locate a few mines would be extremely expensive and time consuming. These mines and any enemy dropped bombs that turn up are dealt with on a case-by-case basis. Because of these scenarios, it is unlikely that old ordnance will be cleared in a time efficient manner. The missed landmines in mine fields remain, and the unexploded bombs still turn-up on the beaches.

It can be effectively argued that mines are used more prolifically in current wars than in previous wars. Perhaps, because of this factor and other variables, humanitarian clearance operations now deploy into war-torn areas almost immediately after the violence has ended. This practice is a new concept to modern warfare and an unusual concept falling under the umbrella of humanitarianism because it was previously a military responsibility. But, as statistics reveal, mine and UXO clearance is a responsibility that has mixed results for the deminer, the civilian, socio-economic development, agricultural land and animals.

Further complicating the problem of mine clearance today is the way warfare has changed over the last 100 years. Earlier wars were fought with recognizable defensive and offensive positions. Battle lines were easy to follow. Current wars and skirmishes are fought often with no recognizable battle lines in what can be described as guerilla war tactics of low technology but high intensity. As these conflicts progress, soldiers rotate, new soldiers lay new mines and locations of previous mine fields may be distantly remembered. Added to this problem is the evolution of mine warfare from defense into offense. Mines are not just placed as deterrents but to kill. Long rebel battles increased the use of government armies of placing mines around settlements, infrastructure, paths and roads. Mines are now placed around civilians—where people live, work, play and commute to town. Mines are no longer placed around recognizable "war zones." Often, the best sources of information about mines are not the rebel and government armies who may or may not keep records of their location but the victims, the doctors and hospitals who treat the mine victims and the civilians of the local mine-infested villages. ■

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Part II

Strategic Management for Mine Action Operations:

A Case for Government-Industry Partnering

by Dr. Alan Childress and Lieutenant Colonel Pete Owen

In March 2000, issue 4.1, The Journal of Mine Action *published the first part of this article.*

Summary of Part I

Directed mainly at policy makers and leaders in mine-plagued nations and government and non-government mine action planners, the article argues for holistic mine action strategies, coordinated priorities and best management practices. The authors establish the need for nations to take charge of their mine action organizations and present strategic management methodology to implement self-determination concepts. They insist that humanitarian demining must start with the end in mind, an integrated and nationally prioritized requirements analysis of each of the mine action areas—mine awareness, mine field assessment and surveys, mine and UXO clearance, victim assistance and information management. They also suggest that nations should consider reconstruction and development programs as well as mine action when contemplating resource mobilization. With nationally prioritized programs and mine action centers managed by host nation-dedicated general managers, nations can expect to achieve optimum resource allocation and, most importantly, to look after their people as a first priority. The authors recommend that nations look to industry for dedicated, first-tier mine action program managers.

An Application

**The following depicts a ficticious country and a proposed demining scenario.*

Pineland* is a multi-cultural nation with a long history of warfare. During WWII, AT mines were planted after several border disputes and, more recently, AP mines were used during guerrilla insurgencies. Pineland authorities have documentation on a few minefields, but mine casualties typically occur in areas where no mine records exist. In addition, much unexploded ordnance within the battle areas exists today. UNICEF reports consistent casualties of adults and children. Animals also suffer a huge number of casualties.

The eastern districts of Pineland, characterized by mountainous terrain and mineralized soil, are sewn with AP mines and large numbers of unexploded ordnance. The western districts, mainly desert terrain, in contrast, contain several types of mines from WWII and a major border conflict. The central districts are infested with various types of AP mines and unexploded ordnance from guerrilla insurgencies. Several demining equipment vendors are pitching their products to district chiefs who have requested national funding for three types of mine detectors: remote control mine detecting vehicles, mine detecting dogs and flails and tillers. Two NGOs have started victim assistance and mine awareness programs in the central and western districts. Only recently has Pineland observed a government that is willing to tackle its mine-infestation problem on a national scale. The prime minister has requested help from the United Nations, World Bank (for development and reconstruction in mine-plagued regions), the U.S. Government and others' and various NGOs. He has accepted the U.N. Mine Action Center's offer of assistance, and several governments and NGOs have offered different types of assistance to him. The prime minister also formally requested U.S. assistance, which was approved by the U.S. Interagency Working Group.

Setting the Strategy

The prime minister and his team should develop a vision of where he would like to see Pineland and its mine problem in five to seven years in concurrence with selecting an experienced, competent general manager to develop and lead his mine action program. In conjunction with the ongoing requirements analysis, he should study the social and economic ramifications of mines in the districts to help determine his priorities. While considering reconstruction, development and resettlement issues, he should convey his vision and priorities to his management team. He should also establish a civilian-led national demining committee, working with local U.N. officials to form a donor committee within that organization. In our view, close and continuous national leadership involvement in the strategy development stage of mine action is essential.

Implementing the Strategy

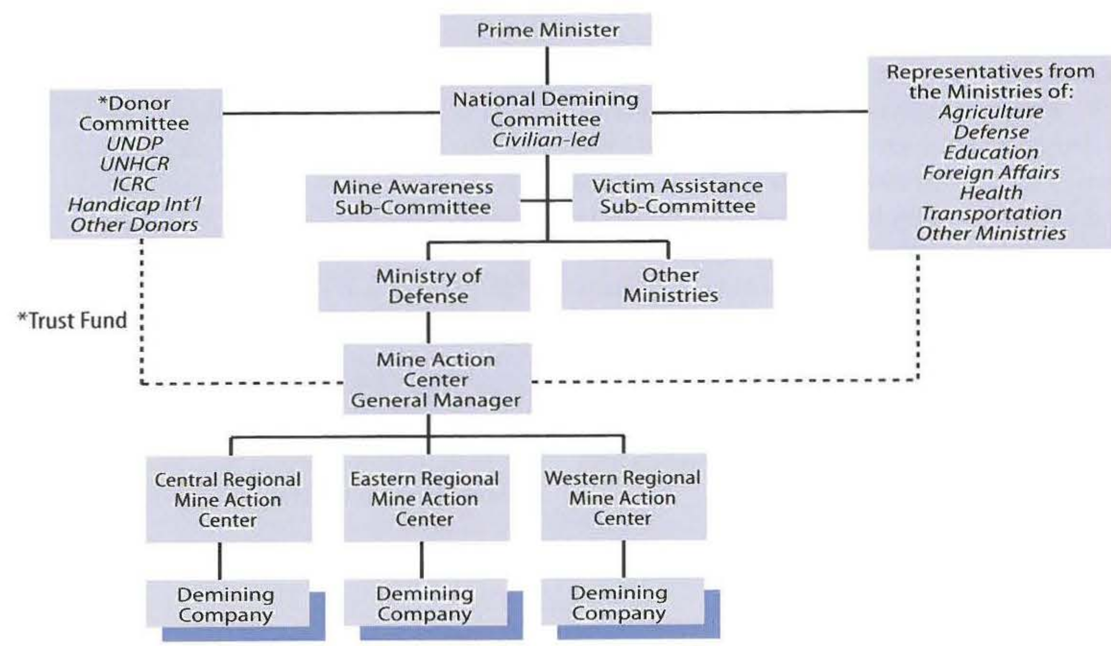
With the prime minister's strategy in hand, planning how to achieve that strategy should be Pineland's general manager's first step. While communicating and coordinating with all mine action players, he should begin defining goals, objectives and events for his mine action center to accomplish. Ongoing projects in the districts are presently consuming scarce resources that may be better allocated in relation to national priorities, and new initiatives need to come under the MAC umbrella. Based on the Level 1 Survey and other data, district managers should develop a requirements matrix for each of the five components of mine action for each mine-infested area. This data should be conveyed to the general manager who should aggregate the data in a Pineland mine action plan, recognizing macro socio-economic factors as well as district needs. The important point is that district priorities may differ from Pineland national priorities, and these conflicts must be discussed and coordinated with donors at the beginnning. Regarding resourcing, for example, would mine dogs currently being contracted for the western district desert terrain be better employed in the eastern districts where mineralized soil and mountainous terrain make mine detectors less than fully effective?

At this point, if the general manager is in place, he should help coordinate the policy assessment visit from the United States to assess Pineland's mine problem and determine if he can provide the required personnel to conduct mine actions. Following that visit, he should help the U.S. team coordinate a requirements determination site survey to determine the detailed material necessary to train the Pineland mine action trainers. He should also facilitate other donor visits to begin the donor coordination process.

Organizing the MAC

By establishing the National Mine Action Center (MAC) and regional MACs in the three districts, the general manager should start to coordinate the Level 1 Survey actions inherent in developing the optimum resource mix for Pineland. The general manager should develop an organization that includes all mine action players, in particular the donors, led by one of Pineland's civilian ministers. While employing military deminers for the humanitarian demining mission is certainly reasonable, the international donor community, including the U.N. and World Bank, requires a civilian mine action leader. The organization chart (Figure 1) illustrates an organization that

Pineland Mine Action Organization figure 1



**This organization is separate from defense units. It is mine action mission only.*

should be acceptable to the donor community. The general manager should also document the processes in his organization, recalling that an organization chart is simply a snapshot in time and speaks little to how the organization accomplishes work. A pre-deployment site survey from the U.S. should arrive to fine tune and coordinate final preparation to train and equip the mine action personnel. This site survey should be followed within a few months by a contingent of U.S. mine action trainers with mine action equipment and supplies, which they will donate at the end of the training cycle.

Resourcing the MAC

Resourcing will provide funding and personnel to support the MAC and RMACs. Pineland's mine action managers will be faced with eight types of demining heavy machinery, nine types of mine detectors, mine detecting dogs, several types of protective gear and ground penetrating radar with the choices growing. How do Pineland planners optimize their resource choices? Most of the decisions will flow from the plan accomplished while developing the Pineland mine action strategy up front. Based on Pineland's aggregated and prioritized requirements analysis, the general manager should meet with all actual and potential donors, ideally at one meeting, to outline his requirements from demining equipment to organizational development consulting. The U.S. team will provide mine action equipment and supplies to get the program started and help maintain it. They will count on the general manager to coordinate discussions with other donors to match or complement U.S. donations.

Controlling Pineland Mine Actions

The general manager should coordinate and develop a data collection system to satisfy at least two sets of effectiveness measures. He needs measures of effectiveness to satisfy his superiors as well as data to satisfy the measures of effectiveness system maintained by the U.S. (or other donors) for their internal needs. He should satisfy safety standards by following UNMAS documentation, which establishes international safety standards. However, quality assurance philosophy should compel him to require the highest standards of training and safety practices from his subordinates.

Sustaining the Operation

Managing with the end in mind and the mine-safe nation his prime minister envisions, the general manager must marshal and efficiently deploy his at hand resources and potential resources to achieve that end state. Coordinated and established control systems will be critical to prevent fraud, waste and abuse of Pineland's mine action resources. Lessons from other countries, such as Chad and Cambodia, should be studied. Pineland will need a plan to conserve and distribute mine action resources for the long term, realizing that they will most likely have continuous tugging from regional constituencies for short-term fixes.

Conclusions and Implications

While we suggest that strategic planning for mine action is distinct from management planning, in practice, management leaders generally combine the functions; thus, the strategy should be developed in the planning phase of the management cycle. We made the distinction to emphasize the importance of determining a country's total mine action requirements before contemplating resources, which most countries tend not to do. Our strategic management logic also applies to countries that decide to outsource their mine action operations. Host nations should lead the requirements analysis phase and provide the general manager to lead their mine action centers. Host nations would do well to advertise their general management needs to international management consultant firms. The investment in an exceptional general manager, beholden only to the host nation government, should achieve significant returns on the investment in terms of humanitarian and resource allocation outcomes.

The implications of well-planned and host nation-managed mine action programs are considerable, including serving the host nation's political, economic as well as mine action agendas. Arnold Sierra, a Foreign Service Officer currently engaged at the U.S. Department of State's Humanitarian Demining Program, suggests that host nations consider an umbrella Development Action Center (DAC), which would integrate mine action and national development and reconstruction activities, supporting self-determination goals. A donor support methodology could be established within the DAC to help eliminate waste, synergize donor support and coordinate activities by the many different donor agencies involved. We note that, as a development agency, the World Bank supports member country programs that help lead to the eradication of poverty and to the promotion of sustainable development. Its support of mine action is based upon the recognition that mine pollution is, for many affected countries, a significant obstacle to the re-establishment of normal development activities. In this context, it shares with UNDP a perspective that views mine pollution as a development problem with long term consequences and, consequently, with long-term solutions that extend far beyond initial humanitarian concerns. Also important is that the World Bank shares responsibility with UNDP for convening donor groups in reconstruction situations and, thus, has a major role in resource mobilization and in setting long term agendas for international support for mine action and other needs. Similar to UNDP mine action policies, land mine clearance in World Bank-financed projects must be carried out under the auspices of civilian authorities, acting as an incentive for civilian-led national mine action committees in addition to setting policy for mine action centers.

Implications for continuous quality assurance, not necessarily quality control, are significant. While quality control at the demining unit level is necessary and important, quality assurance, systematically managed by the general manager, is equally important. Assuring that training and safety systems are well designed, properly taught and rigorously enforced is a function of the general manager, not off-handedly delegated to subordinates. In addition, it is the responsibility of the general manager to establish measures of effectiveness for his mine action center, which tell his boss or the prime minister how the mine action program is progressing. Donors also will need data for their own agendas, which the general manager must accommodate if he expects continuous donor support. Having established its own measures of effectiveness, the U.S. will assist general managers in establishing data collection methods to meet their and other donors' data needs. General managers need to realize the importance of regularly reporting mine action data to donors, helping ensure their long-term support.

Our research and experience indicates that worldwide mine action remains fragmented and uncoordinated. Holistic national approaches to their mine action problems would appear to help sustain stable and generous donor support. Regarding competition for demining resources, holistic approaches may tend to prioritize donor support to regions enduring the most human suffering, rather than those with the most political influence. ■

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Biography

Lieutenant Colonel Pete Owen is the Program Manager for U.S. Central Command's Humanitarian Demining Program. He is responsible for all U.S. mine action operations in the Middle East and African nations that comprise the Central Command's area of responsibility. Much of this article is based on lessons learned while he was establishing and managing the program.

Dr. Alan Childress, a management consultant for BoozAllen & Hamilton, is currently engaged as the Central Command's humanitarian demining Country Manager for Ethiopia, Eritrea and Djibouti. He specialized in international management while earning his business administration doctorate at Nova Southeastern University.

The authors wish to acknowledge the contributions of John Johnson, Country Manager U.S. Central Command Humanitarian Demining Program. "We benefit daily from his extensive mine action knowledge and his compassion for people affected by the worldwide landmine affliction."

profiles

HALO Trust

HALO in Cambodia operates the demining system of One-Man One Lane (OMOL). Traditional mine clearance has operated with three individuals performing detection, probing and trip wire detection/ deactivation. With the use of improved German mine detectors, HALO has safely combined all tasks to a single man, doubling productivity and halving personnel costs.

Established in 1988, The HALO Trust (Hazardous Life-Support Organization) is a non-political, non-religious British registered charity (No. 1001813) that specializes in removing landmines and UXO. HALO has 3,000 mine clearers working in six countries. HALO's operations are grouped under Asia, Africa and the Caucasus. "HALO is not distracted by involvement in campaigns and conferences. We have a simple statement: 'Getting mines out of the ground, now,'" stated Guy Willoughby, HALO Director.

HALO manages its own research and development and also works with scientific institutions. HALO has also trialed Ground Penetrating Radar, dog teams and mechanical equipment. The most successful rate of HALO's R&D has been in the adaptation of existing agricultural and civil engineering plants. HALO has modified the standard European tractor mounted hedge and verge cutter and deployed 10 units to cut vegetation growth in Cambodia, Africa and the Caucasus, which gives safer access for deminers. Twenty medium-wheeled loaders have been adapted and armored for clearing rubble. Area-reduction vehicles have been designed to drive into suspect areas and define the "line" of laid mines. This advancement allows for a better use of clearance time with deminers deployed closer to the actual mines.

THE HALO TRUST

HALO's administrative staff is small. Emphasis is placed on developing local management. They train their managers and deminers as well as mechanics, medical staff equipment technicians and drivers. Mine awareness trainers are also deployed on a limited basis. Its mine clearance teams use a variety of equipment with each deminer wearing protective clothing and face visor and outfitted with the latest state of the art metal detector. Local salary costs for deminers and equipment costs are the largest part of HALO's budget. HALO is funded by a number of private donors, governments and NGOs.

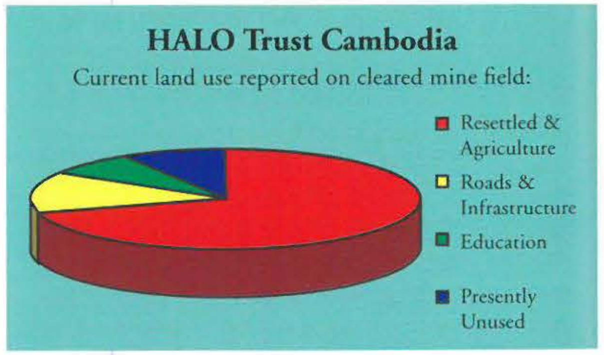
HALO's Programs

Afghanistan

Heavily mined during its 10-year occupation, all defensive forces laid mines to protect their main supply routes, particularly the road north from Kabul to the old soviet border. HALO estimates 640,000 mines have been laid since 1979. Halo started its program in 1988, and now employs over 1,300 deminers, which are split into two 32 manual teams, 10 mechanical teams and six survey and UXO teams. The most common AP mines are the Russian PMN-2 with the distinctive black cross and the PMN. They account for the majority of civilian deaths. Front loaders, cranes and bulldozers have been armored to deal with the mines and UXO amid the rubble of the war torn villages.

Cambodia

During the 10-year Vietnamese occupation, both forces laid landmines. Mine laying increased during 1989-1991, as the Cambodian government used mines as sentinels. The opposition, to prevent the government from extending its areas of control, also laid mines. Highly mined areas include the northwestern provinces bordering Thailand, which had also been the most agriculturally productive and populated. HALO has over 500 deminers split into 16 manual clearance teams and supported by 17 tractor-mounted vegetation cutters.



Africa

Major clearance programs are underway in Mozambique and Angola, and extensive surveys and UXO disposal have taken place in southern Sudan and Somaliland. Anti-vehicle mines have been extensively used on African roads, and though their effect has been less publicized than AP mines, they cause a high number of civilian deaths.

Angola

Programs have concentrated in the Central Provinces of Bie and Huambo. During the 16-year civil war, the government and Cuban forces laid planned, defensive mine fields around key installations while UNITA and other factions mined roads and approaches to rebel bases. After the collapse of the government in the 1992 elections, indiscriminate mine laying took place during the fighting for the provincial capitals. HALO is clearing the wide variety of mined areas that most affect the daily lives of the population.

Demining beside the Benguela railway.

Photo c/o HALO Trust

Mozambique

This program encompasses all four northern provinces of Zambezia, Nampula, Niassa and Cabo Delgado. The government used AP mines to defend provincial and district towns, airstrips, key bridges, power supplies and military posts. RENAMO, Mozambican National Resistance, laid anti-vehicle mines to close the roads connecting towns and markets. In the Zambezia and Niassa provinces, HALO has cleared the majority of the mine fields. The provinces of Nampula and Cabo Delgado will require another three years of concentrated clearance.

Sudan/Somaliland

The Sudan is the biggest country in Africa. Success by the SPLA in 1997 resulted in the front line moving away from the Uganda/Zaire borders. As a result, over 50,000 refugees moved into the Kaya-Yei corridor. They found their villages mined and their fields littered with UXO. The center of Kaya had an ammunition dump. Anti-vehicle mines had been buried in the roads, and until these were cleared, rehabilitation could not start. Somaliland is extensively mined. HALO has surveyed the city of Burao in response to a request by the government of Somaliland. HALO has limited private funding for small programs in Southern Sudan and Somaliland, and both countries require major donor support.

The Caucusus

Chechnya

The Russian army has relied heavily on extensive bombardments in both the current and previous war with the Chechen forces. Air-dropped AP mines and wide mine fields around military positions hold the small country hostage. In 1997, HALO surveyed 286 mined areas and was demining these areas with over 150 Chechens, but this and other programs had to be abandoned in December 1999, because of the fighting.

Nineteen civilians were killed when this Land Rover taxi drove over an anti-tank mine.

Photo c/o HALO trust

Abkhazia

Mines are left over from the secessionist war with Georgia, which was characterized by front lines moving back and forth along the Black Sea Coast. Mines were laid in the flat fertile valleys to augment the natural obstacles of the rivers. These mines have denied land to over 300,000 displaced people. Homes, agricultural land, orchards and industry lie deserted. HALO deploys integrated manual and mechanical clearance teams, maintains a central mine database and a mobile bomb disposal capacity assists reconstruction.

In April 2000, The HALO Trust received 55 surplus Army vehicles from the British Ministry of Defense. This latest donation included Land Rovers, lorries and heavy-duty bulldozers with reinforced buckets that can scoop debris and mines safely. The undersides and cabs of the vehicles will be specially reinforced with armor plating to protect the driver. Some of the heavier equipment will go to Africa where plastic Czech anti-tank mines, which cannot be detected manually, must be detonated by scraping away at gravel road surfaces until they detonate.

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profiles

Mines Advisory Group

The Mines Advisory Group (MAG), U.K. Registered Charity No.1020441, started in 1992. MAG's programs integrate mine/UXO survey, demarcation and clearance with awareness-raising activities to reduce landmine risks to affected populations. MAG's integrated approach prides itself on working with conflict-affected communities to identify and address their most pressing needs.

Through close liaison with the communities, MAG can focus its work on the priority areas that the communities have identified. By training and employing people from mine-affected countries, MAG is transferring technical and management skills to local citizens who can sustain this work.

Mine Action Teams concentrate on tackling urgent tasks, such as providing safe access to water, paths and land for housing, farming and the development of social services. Where applicable, these teams will also survey and mark wider areas of dangerous ground for clearance. The community liaison staff undertakes information gathering and community awareness work; a medic and driver support them. MAG is creating, through its mine action teams, greater flexibility, more multi-skilling and more responsiveness to the broad impact of landmines. MAG will also propose other clearance aids, such as dogs and machines, vegetation and brush cutters and mini-flail machines, in order to better serve the people and their communities.

HUMANITARIAN MINE ACTION MAG MINES ADVISORY GROUP

MAG has established an evaluation process in order to incorporate lessons learned to better serve landmine-affected people and their communities. Recent strategic plans include new development partnerships and an increased emphasis on training in the field. MAG also deploys, where appropriate, its emergency reaction team and a rapid assessment team, which has seen recent work in the West Bank and in southern Sudan.

Current Programs

Kosovo

MAG entered Kosovo in June 1999, initially deploying a Khmer Mine Action Team while training some 60 Kosovans in mine action tasks. MAG is UNMACC's lead agency in the Mitrovica region. In 2000, MAG is fielding three teams and the "minecat" 230 mini-flail. MAG plans to add further appropriate mechanical assistance. In addition to its own mine awareness program, MAG is conducting a Child to Child awareness program funded by UNICEF.

LAO PDR

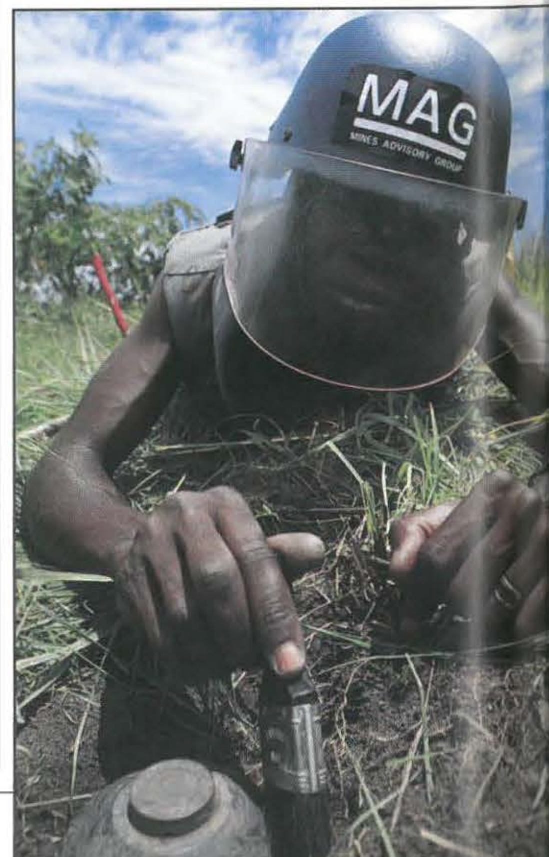
MAG started work in Xieng Khouang Province in 1994. Since 1996, MAG has been working with UXO LAO, the national coordinating body for all UXO clearance activities. MAG has over 200 male and female nationals trained and deployed. Along with direct public education work, their community awareness programs have the integral role in the identification and tasking of clearance teams. In 1998, MAG started work in Saravane Province, southern LAO PDR. Most of the work involves UXO contamination resulting from the bombardment of the Ho Chi Minh Trail. In 2000, MAG is handing over control of the majority of its national staff to UXO LAO.

Angola

The Moxico Province program had been running since 1994. At its peak, it employed 15 mine-clearance, mine-awareness and mine-action teams, consisting of 325 local staff in three locations. Instability and fighting led to the program being suspended in mid1998. Since then, MAG has fielded four active Mine Action Teams in Cunene Province and plans to restart the program in Luana, Moxico Province in the second half of 2000. There are currently two operational mine action teams to respond to the immediate needs of mine-affected communities in the region.

Northern Iraq

Since the program began in 1992, MAG has cleared some one-half million landmines and items of ordnance. With around 650 trained local staff, MAG is one of the region's largest employers. MAG currently fields 17 Mine Action Teams and has built up a comprehensive mine field database which has been made available to other agencies operating in the area. Since 1998, EOD operations have been scaled down as the bulk of surface-lying ordnance was destroyed.



Clearing soil from a Romanian Mai-75 anti-personnel mine, Moxico Province, Angola.
Photo c/o MAG

MAG's work provides benefits to its staff and the local community in addition to the removal of mines and UXO from their land. The wages that the staff earn working for MAG will usually go to support an extended family. This money promotes the economic efforts of the broader community.
Photo c/o MAG

Cambodia

MAG's program, which began in 1992, now employs nearly 400 Cambodian civilians, including 48 amputees and 46 women deminers. MAG's effective information gathering network collated 70 percent of the accidents reported to the national Mine Incident Database. In 1998, a new operation began in Kompong Speu Province where four mine action teams were deployed. Since the onset, improved political stability in 1999 has increased the return of refugees and IDPs into former KR areas, MAG has responded to emergencies in Samlot District near Pailin, and in Kompong Speu province to minimize risk of accident. MAG fields data gathering, community liaison and mine awareness teams in seven provinces, and Mine Action Teams in five. 2000 sees four teams beginning operations in Preah Vihear province.

Namibia

In 1998, MAG conducted a preliminary assessment and general survey of the UXO problem facing the population of northern Namibia. MAG is hoping to help develop a program to tackle this problem.

Southern Sudan

In partnership with OSIL and several development NGOs, MAG undertook a six-week capacity building initiative in 1998, and is planning follow up in 2000, with further capacity building and training in management, technical and data gathering/mine awareness disciplines.

Vietnam

MAG's project is fielding one demining team of 25 civilian deminers. The initial project site is 120 hectares around a heavily mine- and ordnance-contaminated former fire-base in Qio Linh district, Quang Tri province. Phase two of the project, later in 2000, will see the introduction of mechanical means to assist with the clearance.

West Bank

MAG is to conduct a short assessment and clearance operation in a mined area near Bethlehem.

Azerbaijan

A MAG "Training and Supervisory Team" is conducting an eight-month training program with UNOPS for the local demining capacity, Relief Azerbaijan. Forty-five deminers are being trained to tackle the mine and UXO problem, initially in the Fizuli region.

In April 2000, the British Ministry of Defense donated 11 vehicles to MAG for use in its mine action projects.

MAG is also considering other requests for assistance in Africa and the Middle East, in South Asia and in South America.

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Ms. Sengmanee

EOD Technician, Lao PDR.

Ms. Sengmanee was the first female technician in MAG's new program in Saravane Province, Lao PDR. She is from the district of Ta Oi, on the former Ho Chi Minh Trail, where MAG opened an operations base in 1998.

"The people of Ta Oi are very poor and they need more land to farm. A lot of land contains unexploded ordnance that remains from the bombing of the Ho Chi Minh Trail. The people are afraid when they are winding in the rice fields. I want to destroy all the UXO in this district to help my people live safely."

profiles

Norwegian People's Aid

Profile

Operating on the principles of solidarity, unity, human dignity, peace and freedom, Norwegian People's Aid (NPA) is one of Norway's leading non-governmental organizations. Originating in 1939 as a result of the Norwegian labor movement, NPA quickly assumed an active role in Norway, performing rescue, first aid and public health services, assisting the elderly and disabled, offering services during natural disasters and operating reception centers for asylum seekers.

NPA soon became an international figure and expanded its services to include agricultural, environmental, healthcare and psycho-social and human rights activities. NPA also offers emergency assistance, shelters, conflict prevention and resolution and, lastly, mine-clearance and mine-awareness programs. By extending this spectrum of services, NPA has secured its position as a vital force on the international humanitarian aid level and is presently involved in 400 projects in 30 countries. NPA also advocates that cooperation only enhances a humanitarian organization's fight against inhumane behavior. It works closely with the Norwegian Ministry of Foreign Affairs and is a member of Eurostep and SOLIDAR.

Although NPA accomplishes much from a national perspective, its mine clearance and mine awareness programs highlight its dedication to ridding the world of landmines and improving safety for all human beings. It has established a tradition of assisting African countries in their liberation movements, supporting each individual's right to freedom and justice, and has contributed to rebuilding and development efforts in recently liberated countries. NPA categorizes its efforts in Africa into two divisions: short-term emergency relief and long-term development cooperation, with Southern Africa and the Horn of Africa comprising its two prime geographical areas of concern.

Landmine Activities

NPA's landmine projects have taken it to Angola where the organization focused on battle area clearance, mine clearance, survey and GIS database and mine awareness. Its expertise has landed it projects in Angola *and* Bosnia-Herzegovina, Cambodia, Kosovo, Laos, Mozambique, Northern Iraq, Kurdistan and the Western Sahara. In Bosnia-Herzegovina, NPA surveyed the land, established mine clearance and mine awareness programs and deployed 150 deminers and five mine detection dog teams. To assist the refugees in Cambodia, NPA offered local community development programs and supplied technical guidance to the Cambodian Mine Action Center (CCMAT). NPA also incorporates indigenous populations in its projects to promote cordial working relationships between the countries and NPA and to establish a competent demining team to further mine clearance efforts once NPA is no longer a presence in the country. In Kosovo, NPA trained 100 local deminers and dog teams to clear the affected land. As mine awareness comprises a significant portion of the landmine problem, NPA created mine awareness programs for returning refugees in the Western Sahara and trained approximately 30,000 people in refugee camps.

To optimize its efforts, NPA also focuses on the research and development of mine clearance technology, as there is always a need to improve safety, speed and cost concerns for mine detection and removal methods. NPA also emphasizes the need to approach all new technological advancements with a degree of caution, as there is never an easy solution to a problem this severe.

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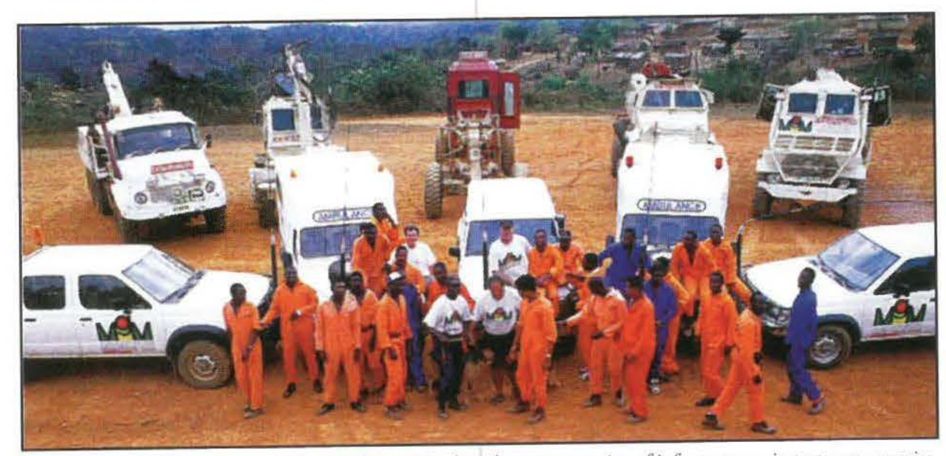
MgM

Founded in Germany in January 1996, by Directors Hendrik Ehlers and Hans Georg Kruessen, MgM, translated to "The Charity of People Against Landmines," has generated much discussion as one of the leading international demining organizations.

MENSCHEN GEGEN MINEN
PEOPLE AGAINST LANDMINES
PESSOAS CONTRA MINAS
MENSEN TEGEN MIJNEN

Intent on upholding and achieving its goals listed in its mission statement, MgM operates "to reopen arable lands, to protect people, to [prevent] landmine [injuries] and to enable mine-affected communities to return to a normal life in dignity." MgM employs highly motivated individuals and regularly retrains its personnel to educate them about new demining technology.



MgM was created as a service provider to other NGOs that plan reconstruction of infrastructures in post-war scenarios.
Photo c/o MGM

Donations and Support

Without the monetary assistance from various concerned persons and organizations, MgM could not function at its current level. The German government and the Netherlands' government helped to fund MgM's Angola project. MgM has formed partnerships with a variety of governments and companies to offer the most cost-efficient and clearance effective services to mine-affected countries. MgM works in cooperation with Windhoek Maschinenfabrik (WMF) and the Namibian Defense Force (NDF). To reduce costs, MgM obtains its armored vehicles from Namibian scrap yards where its personnel can locate war vehicles discarded from previous conflicts. In addition, the U.S. Department of Defense and the SCF US donated cast vehicles to MgM for use in its Angola project.

The MaM System

MgM's policy of safety, quality, transparency, nonprofit innovations and observation is evident in its work. Specialists at MgM designed a mechanically assisted manual demining (MaM) system to ensure the safety of its personnel and the people returning to mined areas. This system consists of a Wolf III Turbo armored vehicle and is equipped with a vegetation cutter, which enables deminers to manually clear the land. The MaM system is followed by a MaD system, which consists of mine-detecting dogs. The last phase of MgM's layered technique is the QaM, an armored grader that scrapes the ground surface of cleared areas for passive quality control. MgM favors a layered approach to demining to guarantee the safety of its staff and people returning to their homes.

MgM Projects and Activities

MgM focuses its operations on measuring the social impact toward mine clearance and the rehabilitation of infrastructures to permit the safe return of displaced persons. Its activities include demining work in Angola and Namibia. German Ambassador to Angola Helmut van Edig requested MgM's assistance to reconstruct numerous mined roadways, bridges and community areas in the Bengo Province of Angola to facilitate Angolan refugees' return to their country. Because of MgM and other humanitarian organizations' efforts, 50,000 displaced persons returned to Angola after seven years spent in refugee camps.

Presently, MgM is in the planning stages of preparing survey operations in Africa and Central America and urges people to remember "with all [the] pride and joy about these hybrid and low-tech products and projects, it must [be] kept in mind that the purpose of both are to clear landmines and UXOs."

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profiles

Mechem

The Mechem division of Denel (Pty.) Ltd., South Africa, has a history going back to the late 1960s, when it was a unit of the South African Council for Scientific and Industrial Research. Specializing in landmine detection, demining and UXO disposal, Mechem also offers contract research and development, well-equipped laboratories and an explosive test range, which is used for the development and evaluation of equipment and augments workshops.

Mechem has designed mine-protected vehicles, including the Casspir and Mamba, which are used for demining, and provided safe and reliable transport for operations. Recent developments include add-on armor systems against SSF mines and modifications to the Schiebel VAMIDS metal detector systems, which enables it to detect and mark the position of mines with minimal metal content.

Explosive Detection Systems

Unlike metal detection systems, the Mechem Explosive and Drug Detection System (MEDDS) combines the mechanical concentration of explosive vapors with the acute sense of smell of trained dogs. By using a team of dogs to check MEDDS sample tubes, it is possible to predict the presence of explosives in the sectors of a mine field. MEDDS is used to indicate the presence or absence of vapor, which can emanate from stray ammo, a weapons cache, UXO or a mine.

Mechem has developed a non-magnetic triller, or pushed trolley, with a Sachiebel VAMIDS array coupled to a computer operated marking system, which paints on the spots where mines are found. The system, mounted on a Casspir, has completed field trials by auditing cleared mine fields in Mozambique.

The International Counter-mine and Canine Training Institute (ICCTI)

Funded by donors, this school provides training in all aspects of mine detection and clearance. The intention is to enable mine-infested countries to become self-sufficient in demining. Training is offered through a variety of standardized courses. Specific courses can also be designed to meet with client requirements, which may include UXO and terror bomb disposal techniques. Standard courses include the following:

Mechem Casspir on a U.N. contract.

Photo c/o Mechem

Basic Demining Course:

Mine Awareness
First Aid
Metal detection
Detection with a prodder
International mine and munitions identification
Explosive characteristics
Driver training
Communications

Advanced Demining Course:

Vapor detection-MEDDS sampling
Rendering safe of mines and UXO
MEDDS dog and handler training
Search dog and handler training
Communications
Operational medical care
Supervision
Quality assurance
Statistics
Logistic support procedures
Vehicle and mechanical maintenance

Mine Surveys

Permanent staff is available for surveying and gathering information about known or suspected mine fields. At the conclusion of an initial survey, Mechem can report the estimated extent of the problem and offer a selection of solutions adapted to the local terrain of the mine field.

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Security Devices

Appealing to a broad range of customers from governments to commercial demining companies, Security Devices offers high quality, economic demining products and has established its presence in the demining community. Andy Smith, an international specialist in humanitarian demining, designs the majority of the equipment Security Devices markets.

Mk3 Personal Protective Equipment

Presently, Security Devices offers an all-inclusive set of personal protective equipment. This set includes an Mk3 demining apron, a 5mm visor and fittings, knee-shin pads and a carry bag to transport these items. Specialists at Security Devices have designed a weatherproof, padded, washable, lightweight carry bag to reduce the bulkiness and weight strain that personal protective equipment often places on deminers.

Mk3 Demining Apron

The Mk3 demining apron does not conform to traditional body armor. Rather than matching previous close-fitting aprons, the designers adapted the Mk3 apron to hang comfortably from the shoulders, forming a blast-proof wall between the deminer and the mine. Aware of the environmental conditions under which deminers often work, the specialists designed the apron to support air circulation, which cools the deminers as they work. In addition, the specialists at Security Devices overlapped the apron's collar with the 5mm visor also supplied in the kit. This modification protects deminers if they detonate a mine while looking down as they work. This apron has been involved in a minimum of 12 prodding incidents, establishing its worth as an effective means of protection.

5mm Visor

The 5mm visor, composed of polycarbonate, is equipped with a head-frame made from ballistic Aramid and covered with waterproof nylon. These specifications improve the durability of the visor and the protection it offers, increasing its growing popularity among deminers.

Knee-Shin Pads

To improve the comfort factor of demining, designers included knee-shin pads in the personal protective equipment kit. Although the pads do not offer significant protection against exploding ordnance, deminers have reported that the pads are beneficial when they are forced to kneel on damp or rough ground to work. The pads are made of rubber and designed to be flexible to match a deminer's physical movement.

Manual Demining Hand Tools

Andy Smith, aware of the injuries caused by exploding mines to exposed hands, created a range of hand tools to reduce this risk. These tools include the "Braveheart" excavator, the "pick-prod," the "mini-spade," the "MIT profile" probe, the "root cutter," the mine-grab and the demining brush, markers, shears and tool set. The tools underwent multiple tests to ensure their safety. Deminers can purchase the complete set of tools from Security Devices as a toolbag. In addition to the previously mentioned tools, the set supplies a tripwire feeler, maintenance tools and a saw.

Development and Testing

Security Devices firmly believes in the integrity of each of its products. Therefore, the organization uses strictly quality materials, including polycarbonate, Aramid and Kevlar. Its test facility is equipped with a fragmentation firing rig that fulfills NATO standards. Prior to each product's release to the market, Smith subjects his designs to rigorous testing, measuring the protective value the product provides under real conditions. In addition to their marketed products, Security Devices will adapt equipment to meet specific requirements upon request, understanding deminers' individual needs.

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GERBERA Gmbh

Comprised of a staff comprehensively trained in international operations involving project management and mine clearance, GERBERA Gmbh strives to offer a range of services to mine-affected countries. These services include the following:

- Mapping and analyzing mine-contaminated areas;
- Preparing, implementing and inspecting "tendered documents";
- Providing emergency assistance against mine hazards;
- Detecting, neutralizing and removing mines;
- Performing quality assurance tests; and
- Training and supervising local deminers and EOD workers.

To ensure its deminers operate at maximum efficiency and skill, GERBERA provides its deminers with computer aided data acquisition and evaluation equipment for land and water mine detection and removal. While some mine clearance organizations are limited to land work, GERBERA distinguishes itself as an organization capable of both land and water mine retrieval.

Mine Awareness

GERBERA emphasizes the need to increase mine awareness programs tailored to the children and parents inhabiting mine-affected areas, as education is a primary means of preventing future casualties. The organization has offered classes in many of its project countries in an attempt to generate mine awareness knowledge among the most severely affected populations.

Mine Clearance Projects

In 1996 and 1997, GERBERA's projects took its deminers to Angola where demining specialists performed quality assurance tests on approximately 4,800 km of primary roadways. During a U.N. Peacekeeping Mission in Angola (UNAVEM-III), GERBERA experts worked as regional mines officers and supervisors for the Angolean Demining Brigades and as U.N. Quality Controllers for the demining and UXO clearance efforts.

Deminers for GERBERA endure strenuous, tedious work. Often, they confront UXO dating from resolved wars. In Laos, deminers located a variety of UXO, some of which was dated as far back as the 1940s. Consequently, GERBERA supplies its deminers with advanced technology to succeed in its mine clearance and awareness missions.

In addition to mine clearance efforts, GERBERA also trains local deminers to continue demining efforts. In Vietnam, GERBERA instructed locals to serach and clear mine-affected areas in order to quicken the resettlement of two villages.

Equipment

GERBERA stresses the value of innovative technology in demining efforts. In an attempt to restore the national infrastructure in Croatia, GERBERA deminers combined machinery, manual demining techniques and mine detecting dogs to clear heavily mined areas. GERBERA also utilizes computer software to assist in underwater detection. In addition to detection, the software is also able to measure the extent of pollution and the related dangers prior to GERBERA's initial demining efforts.

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Intersos

History: INTERSOS is an Italian based organization founded in 1992, by a group of individuals who had already dedicated years of aid and understanding to victims in developing countries. INTERSOS is a non-profit, independent organization that works to support public and private institutions that share its perspective in aiding the victims of humanitarian tragedies across the world.

It is also a member of the European Coordination VOICE (Voluntary Organizations In Cooperation in Emergencies) and a member of the project SOLIDEA that is a part of the Italian Trade Unions special interrelations. The organization's primary goals focus on the appropriate skills needed to help the victims of landmine and other disasters. The group is based upon solidarity and "professionalism" so that it can work quickly and efficiently to cover as much ground as possible. Since 1992, INTERSOS has been recognized by the Italian Ministry of Foreign Affairs and by the European Commission. Both of these organizations, along with several other humanitarian organizations, support the gallant efforts of these individuals.

Primary Goals: The main goal of INTERSOS is to immediately respond to all types of disasters and to bring aid to the victims of armed conflict, drought, famine and landmine explosions. Through its fight to save more lives, INTERSOS also works to restore the normalcy of everyday life before these conflicts arise. INTERSOS believes the most efficient way to enlist outside help is to tell the public and let them contribute to the local associations as well as the overall cause. One aspect that INTERSOS prides itself on is following a strict non-sexual, racial or ethnic discrimination policy. All of the people involved work hard to spread the word of these disasters and enlist as much humanitarian aid as possible.

Resources: INTERSOS is an organization supported by several different pillars of contributors, such as doctors, nurses, logisticians, administrators, educators and technicians in engineering, sanitation, human settlement, agriculture, electro-mechanics and explosive devices. These pillars of INTERSOS work together to attend to the areas devastated by tragedy and left in despair. Financially, INTERSOS is not only supported by its own members' contributions and various individuals but it has also benefited from the help of several different NGOs and other organizations, including:

- European Union—ECHO, DG IA, DG VIII
- Italian Ministry of Foreign Affairs
- UNHCR
- UNICEF
- USAID
- Italian Episcopal Conference (CEI)
- Italian Caritas
- Trade Unions

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profiles

Sankt Barbara

History: Stiftung Sankt Barbara is a private foundation with its central headquarters in Munster, Germany. The organization was established in 1995, but its first mission was organized in October 1996. Sankt Barbara is a non-profit organization whose purpose is to protect the native people of different countries through knowledge of landmines, accurate demining and rehabilitation.

The organization is based upon the guidance of a board of directors, which handles the foundation's business and capital, and a board of trustees, which advises the board of directors and gives the foundation a set of business regulations to follow. The only other authority over Sankt Barbara is that of the Luneburg government, which requires the directors to keep them informed of projects and problems as well as to turn in a yearly balance with a financial outline of the money spent. This practice ensures that every penny is saved for the demining and rehabilitation process for countries in need. Throughout the course of its ascension in the demining field, Sankt Barbara has worked hard and trained hundreds of new deminers in order to clear as much land as possible, as quickly as possible. Its purpose is to make new and improved advancements in the medical care of war victims, orphans and those who were disabled due to circumstances beyond their control as well as working on economic issues within the developing country.

Mission: The mission of the organization is to remove as many landmines as possible so that there are fewer victims. Coinciding with its goal of demining, it also focuses on assistance for native people and their lands in the hopes that the people can resume their normal lives. It is also involved with the medical care and rehabilitation of mine victims. The people of Stiftung Sankt Barbara work together to ensure that adequate help and attention is focused on the victims' integration back into society and education on how to care for and handle the prostheses.

Current Projects: There are several locations in which Stiftung Sankt Barbara is working, but Angola and Somaliland are its two major areas of concern. In 1997, it began the quest to remove landmines in Angola. It is currently stationed in the Huila Province of Angola at Hoque where it is demining a large mine field on the side of a hill filled with old Russian mines. This crusade is funded by the Italian Embassy with a staff of 30. Another chief site in Angola is Camp Xangongo, a logistic base staffed by 12, located in the Cunene province and funded by a coalition of German companies. At this site, it is working to demine agricultural lands for the surrounding communities. They, too, are plagued by old Russian mines. Most of the landmines were produced in China, Romania or Russia, but some were brought from Germany, South Africa and the United States.

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UXB International, Inc.

The mission of UXB is to provide a world-class, comprehensive program of demining-ordnance and explosive waste (D-OEW) remediation-engineering services designed to meet the needs of a diverse client base in a safe, effective, cost efficient manner while complying with increasingly stringent regulatory requirements. UXB is committed to providing quality programs and services using an integrated systems approach, utilizing state-of-the-art science technologies and field-proven methodologies by well-qualified and highly trained personnel under the supervision of a streamlined, responsive, customer focused management team.

As a major participant in the global effort to remove landmines, UXB is an international leader in safe and efficient clearing of landmines and UXO. Its landmine clearance efforts have taken them all over the world from the jungles of Vietnam to the war ravaged communities of Bosnia-Herzegovina. UXO operations have been even more widespread.

UXB places the highest importance on working side-by-side with the host nations to educate citizens about the dangers and complexities of working in mined areas. UXB augments, expands and consolidates the experience and knowledge of former combatants, military personnel and other local experts so that the required work and clearance standards of the multi-national workforce can be safely and efficiently met and maintained. The aim of UXB is to leave the affected communities with an indigenous capability and capacity to ensure long-term success neutralizing the landmine threat. It has developed specialized training courses that utilize classroom lectures, technical manuals, hands-on reinforcement training, field exercises and formal testing.

Current Projects

Several current projects, most notably those on the Kaho'olawe Island Reserve, Hawaii; Bosnia-Herzegovina; and many others throughout the U.S., have been models of community involvement and participation. UXB, working with PeaceTrees Vietnam and others, cleared land for re-use where the Dannan Parry Landmines Educational Center was built in Quang Tri Province, Vietnam.

Demining Capabilities

UXB has mobilized and deployed multi-skilled and equipped teams tailored for specific missions and tasks, such as conducting landmine surveys, conducting landmine and UXO clearance operations, developing and conducting site-specific landmine awareness/avoidance training, establishing landmine action headquarters, establishing a landmine database, providing explosives storage plans and facilities, establishing a local demining capability and introducing new demining technologies.

UXO Capabilities

Demining teams need additional technical capabilities to safely defeat UXO. For more than 14 years, UXB has successfully located and removed/eliminated UXO at depths well in excess of the United Nations 200 millimeter clearance standard for landmines. UXB has the capabilities to conduct wide area assessments tied to geophysical mapping, integrate surveys into databases, including geographic information systems (GIS), conduct UXO clearance operations on land and underwater and employ risk assessment and footprint reduction.

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profiles

Geomines: Exploring Manual Demining Techniques

Since its creation, Geomines has assumed an active role in the demining community. Accredited by the United Nations, the European Commission and the BHMAC of Sarajevo, Geomines is the result of the combined efforts of marine-oriented Geocean Solmarine and the mine clearance-oriented E.O.D. New Technologies.

Together, these two companies have established a competent organization capable of neutralizing all types of UXO in all potential situations. Geomines has successfully completed missions in Bosnia, Cambodia, El Salvador and Egypt, among other places.

Many countries utilize Geomine's deminers, as they possess the technology and skill to neutralize UXO in all situations.

Photo c/o Geomines

Many countries utilize Geomine's deminers, as they possess the technology and skill to neutralize UXO in all situations.

Geomines' expertise extends to these areas:

- Atmospheric and Underwater Mine Clearance Operations,
- Ammunitions Retrogrades Demolition,
- Toxic Ammunition Clearance Operations,
- Rock Blasting Operations, and
- Pyrotechnic Safety Regulations.

Confident of its technical abilities, Geomines offers its services regardless of the environment. It has successfully dismantled UXO on all-terrain surfaces, such as urban regions, jungles and deserts, in addition to aquatic areas, such as seas, rivers and swamps. This ability accentuates its appeal and emphasizes its uniqueness, as many mine clearance organizations focus largely on landmines.

EOD and IEDD Missions

Primarily, Geomines contends with Explosive Ordnance Disposal (EOD) Missions and Improvised Explosive Device Disposal (IEDD) Missions, both of which consist of the detection, neutralization and/or removal of UXO. These munitions are typical manifestations resulting from two situations: war and/or terrorist (guerilla) warfare. While warring parties might target a specific sector, their actions affect the total population of a given area, rendering the entire area unsafe. As it is impossible to guarantee all ordnance will explode during combat, ordnance planted under war or terrorist pretenses possess the potential to remain dormant and invisible during conflict, patiently waiting for an innocent civilian to unsuspectingly trigger them.

Regardless of the individual, exploding ordnance causes indescribable injury to its victim and restricts a community's free movement; consequently, Geomines enters the picture, hoping to serve as an effective vehicle of assistance. Geomines operates "to preserve the safety of civilian populations and to protect and ensure free circulation within [the] most sensitive zones, such as: [sic] airports, ports,..., railway stations,..., communication centers...." Geomines attempts to neutralize mine-affected areas to support and promote the uninhibited movement of community members.

Methodology and Training

Geomines firmly believes in applying a methodology based on performance, cost and lead times to its demining efforts to ensure civilian and team members' safety. To successfully demine a specified area, the ensuing measures must be organized and methodical, protecting all involved people. Geomines initiates each individual demining mission with an active management selecting a qualified team. Geomines demands each team member be a motivated, competent individual alert of the safety hazards and environmental constraints involved in demining. They also require each member's absolute compliance with its regulations in an effort to reduce the risks involved.

To perform the EOD and IEDD missions, Geomines insists each crew member attend and complete training courses tailored to not only their particular mine clearance skill but also to fundamental demining knowledge and interpersonal relationship skills. Subsequently, all Geomines' personnel are trained to

- Take preventive measures in the case of discovery of ordnance;
- Manage/control a crisis situation;
- Intervene on all conventional ordnance; and
- Intervene in actions against IED.

Additionally, in an attempt to further the team members' demining education, experienced instructors conduct the next phase of the training. These sessions concentrate on the level of security associated with each mission and the specific methods and equipment the future deminers will soon employ in the field. The instructors incorporate accepted pedagogical techniques with personal experiences to educate the team members of the dangers involved in demining and methods to avoid these risks.

EOD Training

Geomines structured the EOD training around several key features. Its first teaching objective focuses on the prevention and the appropriate reconnaissance course of action when handling ordnance. Next, the trainers instruct the future teams on modern ordnance and ammunition interventions, which is followed by a course on underwater reconnaissance and interventions on ordnance. The last covered topic outlines the handling of pyrotechnic devices and the necessary safety precautions involved in this type of mission.

IED Training

This training emphasizes the threat of terrorism more than the act of war (IED ordnance typically results from terrorist actions) and the degree of sensitivity required to successfully detect, neutralize and dispose of all IED. Team members are instructed in areas of surveillance and protection of highly trafficked zones. Lastly, team members are instructed in IED intervention.

Geomines requires all personnel to repeat refresher courses to guarantee its teams are knowledgeable of current technology and methods to successfully demine affected areas. Geomines strives to establish cooperative relationships with local experts and aid agencies, thus modifying present resources to increase the demining efforts and to provide effective assistance to those in need.

Equipment

Currently, Geomines strives to utilize innovative demining technology in its missions. With present technology, it is able to detect PMN, US M42, V69, POMZ-2 and A/T bombs at a maximum depth of 33cm. It also possesses sophisticated technology to detect mines at a greater depth, such as six meters and lower.

As one of Geomines foremost concerns involves the safety of its deminers, the organization supplies its employees with state-of-the-art Personal Protective Equipment (PPE). Once the deminers are appropriately outfitted, they have a selection of detecting equipment to choose from in accordance with their mission. To fully supply its deminers' needs, Geomines provides artificer's equipment. Geomines also possesses a wide range of neutralization equipment to fulfill the requirements of each mission in addition to intervention equipment for IED missions.

With the wide range of protective clothing and equipment Geomines supplies, its deminers feel secure in their missions and subsequently provide effective service to mine-affected countries.

Photo c/o Geomines

With this pioneering technology, Geomines eases into the 21st century, possessing the knowledge, skill and equipment to effectively assist mine-affected countries and helping to eradicate the world of this disastrous problem.

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Mines Clearance International

History and Objectives

Mines Clearance International (MCI) is an established humanitarian demining agency and a registered charity in the U.K. A fairly new organization, MCI was established, in April 1996, to respond to the problem landmines and unexploded ordnance posed to civilians, particularly in the underdeveloped nations of the Southern Hemisphere. MCI staff, though newly on board, includes well-qualified technical and aid personnel with experience in humanitarian responses to the landmine issue.

MCI's objective is to clear land contaminated by landmines and to return it in a safe condition to the most vulnerable groups within the local community. The approach used to bring MCI to its goal is one that aims to transfer technical and organizational skills to local people, such that a sustainable and indigenous capacity can be developed and clearance work can continue long term with minimal expatriate involvement.

The MCI Approach: MCI has eight major outlined approaches that help it maintain and meet its goal. Those approaches are as follows:

Efficient and Cost-Effective Administration: MCI is committed to lean but efficient administration and project support from the U.K. and in-country program offices. Staffed by experienced humanitarian aid workers, MCI's support offices keep overhead costs to a minimum while ensuring that the field teams have the necessary level of professional support to operate effectively. The administrators will also ensure that global MCI policy is rigorously enforced throughout the country program down to the remotest operational cell.

Professional Staff Policy: Only the most well qualified Explosive Ordnance Disposal (EOD) and landmines specialists, with demonstrated training abilities and leadership qualities, will be deployed to the field to work alongside local staff. As in any organization, selecting the right personnel is critical to an effective operation.

Provision of the best quality: MCI adopts a total quality approach with regard to demining equipment, especially safety equipment, and provides up-to-date technical and safety equipment to all local mine clearance operatives as a standard. MCI's Standard Operating Procedures (SOPs) and its technical and safety equipment all conform to the highest internationally recognized standards.

A commitment to training and the development of indigenous capacity: MCI will assess the technical aspects of a problem in any location, as well as the caliber and educational standards of the local staff, and design specially tailored training packages that will be available to donors from the beginning of any operation. Such training packages will detail the curriculum areas to be taught and the skills to be transferred as well as the necessary time tables to realize a staged development toward fully indigenous operations. Such training of local staff would not be restricted to purely technical skills but would include the full range of project management, policy and finance/administrative skills necessary to hand over operations across the board.

An integrated approach: MCI is committed to implementing an integrated approach, consisting of Mine Eradication, Mine Awareness & Data Gathering, to the problem, which means that developing local mine clearance and eradication capacity cannot be seen as the limits of program activity. Mine Awareness (working with mine-affected communities and assisting them to live more safely in their contaminated environment) is essential due to the widespread nature of the problem in the affected areas and the inevitable slowness of the clearance response. Data Gathering, primarily through collecting and analyzing reliable mine victim data, is also important to understanding which communities are under the most stress from landmine contamination. Therefore, MCI can target the limited clearance resources to the worst-off communities first, as such an effective data gathering program has shown to give inhabitants of mine-affected areas a voice in the prioritization process.

Effective Prioritization of the land to be cleared: Prioritizing the tasks that will produce maximum benefits for the most vulnerable groups within any target community is one of the most daunting tasks facing humanitarian demining agencies. MCI will achieve effective prioritization through a variety of strategies.

Effective land titling of demined areas: By working with the local authorities, especially bodies such as the Rural Development Committee in Battambang, Cambodia, MCI will aim to ensure that the land cleared for economic and residential use by those selected as the most vulnerable sector of the population actually remains with these target beneficiaries in the long term. There have been examples where demining agencies have worked for several months on demining projects only to see them taken over by the military.

A flexible, mobile and responsive operational philosophy: In countries such as Cambodia, demining agencies have traditionally operated large teams of 32 deminers. While these teams are ideal for clearing large areas of land due to the requirement of maintaining 25 meter safety distances between each working pair of deminers, such team sizes waste manpower on smaller tasks. However, experience shows that many of the mine fields and urgent task requests reported to the teams are, in fact, too small to allow full 32 men teams to be gainfully employed. MCI's willingness to be flexible with its personnel and team structure on the ground means that it can be more responsive to the real needs of the community, as well as providing more cost-effective demining services for its donors and target beneficiaries.

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from the director's desk: Dennis BARLOW

Saving Private Hashim

by Dennis Barlow, Director, Mine Action Information Center

SOMETIMES, A SUBJECTIVE EVENT can focus our thinking the way objective knowledge cannot. The movie "Saving Private Ryan" had the extraordinary effect of causing millions of cinema fans around the world to marvel and, hopefully, to ponder the extent to which we sometimes go to protect the life and dignity of one individual. The premise was that the policy, strategy and resources of a major country at war could be altered in such a way to defy objective logic (risking far too much for one individual) for a limited goal, in this case—to ensure the viability of one family. It occurred to me that the same dedication should be considered for the "foot soldiers" of the mine action world—the demining operators.

Some time ago, I, perhaps callously, more likely out of ignorance, put deminers (detection and clearance personnel) into an all-encompassing category of mine action practitioner's writ large. Paramedics, geographic information specialists, logisticians, food handlers, technicians, psychologists, sociologists, health providers and deminers, I reasoned, were each important and all necessary for a successful mine action program. What I did not recognize was that the risks associated with mine detection and clearance personnel puts them into a category unlike any of the others. Of course, I realized that their situation was different, but I never consciously analyzed the ramifications of this difference until two events occurred.

Dennis Barlow

The first was when I heard two researchers discussing the pros and cons of particular versions of protective visors for deminers. When they had both had their say, a director of field operators who had been listening in the background quietly responded by saying that the deminers he supervised would opt against using either. Their reason? They would, he explained, much rather take an explosion full in the face and die quickly than to put up with hot, irritating visors, which would only protect the face partially and, perhaps, cause extra agony in case of an explosion. This bit of reasoning, whether logical or not, somehow humanized this argument, which is rarely represented on the podium of well-choreographed seminars and mine action conferences. Up to that point, I had always heard the (supposed) empirical analysis of personnel protective gear, not the mental reactions of the men and women who wear them.

The second milestone for me was when I read a university researcher's report examining the psychological effects of landmine accidents on surviving team members after a member of the demining team had been seriously injured or killed by a mine explosion. Professor Echterling, in his "Critical Stress Incident Debriefing Guide," made the point that deminers, like firemen or policemen, can undergo serious mental turbulence in the aftermath of such a tragedy. The chilling effect of such an incident might not only traumatize individual mine clearers, but it might result in a kind of contagious reluctance to return to work or to continue with mine clearance altogether.

The importance of the effects of these observations has led me to conclude that we need to take a "Private Ryan" or, more appropriately, a "Private Hashim" view of the mine action world. That is, since the clearers and detectors are the "shock troops" of mine action, they need to be protected and considered to an extent, which outweighs their political clout or their simple economic worth. Deminers are not a particularly articulate or diplomatic group of people; they are literally the "guys at the pointy end of the stick."

It is because of this fact that those of us in the landmine information, policy, management, strategic and logistic businesses should pay special heed to the safety and effectiveness of this largely silent but critically important group.

Without [deminers], the entire finely orchestrated global fabric that is mine action would rot and rip apart. Policy goals, donor vision and management objectives would all go unfulfilled without the operator at the lowest level doing the riskiest job in the mine action business.

This is not to imply that the research and development community has not continually had the interest of these operators upper most in mind—it has. Innovative thinkers like Dr. James Trevelyan, Colin King and Andy Smith have helped create an unofficial network of requirements and resources that help manufacturers and mine action organizations create new and modified protective equipment. The donor countries and their R&D institutions have paid particular attention to the need for personnel protective equipment. Because they have funded research, development projects have produced many enhanced products.

Most often, it is the local operator who fine tunes a basic equipment package and makes it more effective in a specific environment. Thus, local operators such as Hendrik Ehlers (MgM, Angola) can modify equipment while an organization like Med-Eng Systems Inc. may consider local modifications for future designs of its products. It is this kind of exchange and feedback between local operators and manufacturers that we encourage and see as the best way to fashion new and effective gear. And it is the support of that process by donors and policy makers that will make it possible. It is to this spirit of dedication to the deminer and cooperation among diverse organizations within the international mine action community that this issue of the Journal is dedicated. ■

editorial: Joe LOKEY

It's Mine and You Can't Have It!

Feeding the Information Appetite or Starving the Data Hungry?

by Joe Lokey, Deputy Director, Mine Action Information Center


Joe Lokey

IT SEEMS TO BE A GIVEN in the mine action community that you are acknowledged as an "expert" simply because you have stood up and declared it so. As with many humanitarian pursuits, there is no process to credential, certify, or license individuals, processes, or procedures in mine action. There is no guild or professional body to oversee and validate the veracity of performance claims. This is frustrating to donors and funding organizations that have little upon which to base outcome expectations. The answer is an open information system and process, transparent reporting, and contributions from the scientific community that are based on solid testing and unbiased findings that tie performance to expected outcomes.

In this issue of the *Journal of Mine Action* we have solicited a variety of articles on manual deminers and their personal protective gear. As you will see with many of the articles, this segment of the community seems to use basic information about what it can and cannot do more than the other segments of the landmine community. Numbers are important. Decisions are made from them. It seems, however, that information, though wanted by everyone, is shared by few. Curious? Not when you consider the nature of the mine action.

For example, where is this empirical support to the preposterous claims accompanying mechanical equipment releases and developments? Why don't the mine detecting dog people publish the results of their dog teams efforts in detail? Even those organizations working with victims are reluctant to publicize numbers and data that support their level of effort. Colin King once observed that "one of the greatest obstacles to progress in mine action was peoples in-built reluctance to cooperate" and posited the concept of "information non-cooperation." There are a variety of reasons behind this such as:

Sensitivity

In spite of the well-intentioned proclamations of most groups and governments, many are sensitive to reporting of casualty rates, number of deminer accidents, causes of accidents, and number of people receiving effective mine awareness education. Sometimes simple nationalism takes over and raw data is frequently manipulated or held in order to either minimize the appearance of incompetence or overstated to influence a more positive message. This reluctance to open organizational or governmental performance data is regrettable and leads to suspicions that can be even more harmful and less productive. Trust needs to be established between those owning the data and those using and basing decisions on that data.

Competition

NGOs competing for programs and for the funding that goes with them, as well as commercial companies competing for contracts, frequently view the donor pool as a zero-sum entity in which giving to one somehow takes away from another. The fear of "donor fatigue" is, as of yet, unfounded as funded programs seem to be bigger and bigger and donors are still actively seeking solid, outcome-based proposals. Although the Canadian Mine Action Investment database provided for UNMAS is a start, more donor information needs to be made public after tenders are awarded so that the mine action community begins to feel there is plenty of work to go around and funding to support that work.

Silver Bullet Syndrome

Research facilities protecting their inventions and developments are the absolute worst at sharing incremental achievements in technology fearing the cross-flow will result in others capitalizing on their work. Hopes for commercial exploitation of new technologies (including patenting) is driving a considerable amount of useful information, technology, and data underground waiting for some opportunity to synthesize it and give it utility. It's like everyone has a small piece of a jigsaw puzzle but no one wants to connect their piece with anyone else so that the picture ("answer") may be revealed to all. There will never be a single technology that "does it all." Any metaphorical silver bullet will necessarily be a multi-sensor platform with a complex but reliable data integration and fusion routine. However, this will be impossible to achieve as long as everyone sits on their own little part of the solution.

The Politics of Ego

Personal and professional competitiveness is a part of any discipline and this is no different. Without a clear distinction among professionals, their worth is built on their backgrounds and experiences though they are frequently embellished because few are the wiser. Few résumés and CV's receive the attention and scrutiny that they should because this inflation of fact permeates the industry in general. On the brighter side, this is a small community and the less capable and charlatans are known to most and don't last long on the more significant projects. *See also, "Cowboy Chic."*

Donor/Corporate Expectations

Expectations of success are generally overstated because of the inability to articulate clear and measurable goals and outcomes. The data required to determine if goals have been met is rarely released therefore comparing planned productivity of operations to the reality of demining or mine action outcomes is difficult at best. Corporations also have an expectation that off-the-shelf technologies unusable for other purposes can somehow be adapted to current demining needs which explains their inability to produce widely useful tools and equipment.

Cowboy Chic

Information that could be used to benefit the entire community is frequently held by the ex-patriots and international workers who feel that they have the experience and expertise and don't feel like the hordes of newcomers are worthy of their time. Some have signed on with larger contracts that force them to act like adults while others continue to claim an absolute position of unquestionable authority based on frighteningly little true experience. Some of these are independent consultants who feel their "longevity" around landmines grant them some sort of right to withhold data and information unless a sizeable check accompanies the request.

Welfare

Less common, but typical of smaller NGOs who have built long-term relationships with donors, are situations in which agencies seeking to sustain long-term government funding (no incentive to complete a program) are reluctant to pass information to anyone other than their benefactor. Some larger donors, and even governments, have their "favorites" or trusted agents to whom a disproportionate share of tenders and contracts are awarded in this quasi-welfare system that keeps less-than-efficient actors on the mine action stage.

Cost-Benefit Malady

A relatively new disease striking donors of large sums is the paralyzing ability of under-funded and poorly funded organizations to ask for a clear relationship between dollars spent and outcomes produced. Governments are apparently stricken more than others with the symptoms of the disease being non-responsiveness and incoherent answers to relatively simple questions. The utility of the answers, even if true and forthcoming, are questionable but there does, indeed, seem to be a chronic reluctance on the part of governments to accurately account for funds spent on mine action initiatives.

Uniformed Ubiquity

One rarely encounters a landmine problem without encountering the military in some shape or form. In some countries, the military are the exclusive owners of all clearance capacity and information. In others, military trainers and advisors pass along skills and knowledge while lending considerable logistic and communications support to clearance efforts. In spite of everything militaries have to offer, there is a strong propensity among all militaries to distrust civilian institutions, especially aid agencies, and, as a consequence, withhold valuable and useful information. This is changing albeit slowly as more integrated efforts occur and trust is built. Similar to the *Silver Bullet Syndrome* above, military research and development results and outcomes are also classified and withheld for years before emerging into the public realm based on fears that new technologies in countermine R&D would be challenged by an adversary. This may be particularly true in the sensor area more than others.

Signatory Sickness

In one of the more perverse consequences of international cooperation, there seems to be a reluctance among signatories of the Ottawa Convention to not share information with non-signatories of the convention. In a self-defeating act of self-righteous indignation, this refusal to both provide and share useful information to organizations attempting to assist in mine action efforts is having the unintended consequence of actually slowing progress and making the entire effort more costly thus killing or injuring more people that could have been saved. This form of moralistic political partitioning is not only harmful it's just plain silly.

In short, we see a common thread of "information = power" running through nearly all of these which seems to typify the frustration and outlook of many. Unless and until there are more teaming arrangements, multilateral contract awards, partnerships and other trust-building measures taken that emphasize comparative advantages, this inability to access simple common data for the greater good may actually get worse before it gets better. The United Nations and other large donors, particularly through the Mine Action Support Group (MASG) and other like efforts, can play a great role in opening these doors by encouraging through contracts and bilateral relationships an open systems architecture for all mine action data and information. Host country mine action centers (MACs), who have historically and understandably not programmed manpower for this, can add functions to their staff that enhance their ability to collect and disseminate information of wide use to a variety of people and organizations.

It's just data. It's not evil and it won't bite. As this issue of the *Journal* demonstrates, the PPE community is doing a decent job of getting good data out to you, the consumer, on what you need to know to make more informed choices. The job ahead of all of us is too important to continue with practices that are both petty and irrelevant to efforts to rid land of mines and UXO. There are enough challenges and obstacles facing all of us without simple communication being the first casualty of any operation. Talk to us and tell it like it is. The objective, after all, is to make the process better. Right? ■